B/GRAPH™

Atari™ Edition

Program design by Michael H. Reichmann and Robert Wilson
Written by Michael H. Reichmann and Robert Wilson

Manual written by Ian Chadwick
Package design by Abraham Tanaka Associates Limited
Package cover illustration by Ken Steacy
Manual design by Abraham Tanaka Associates Limited

BATTERIES INCLUDED™
"The Energized Software Company!"

186 Queen St. West
Toronto, Ontario
M5V 1Z1 Canada

Telex 06-218290
(416) 596-1419
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17875 Sky Park North
Suite P, Irvine, California
USA 92714

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This documentation features as its main component, a Tutorial that will demonstrate each of the functions and capabilities of B/GRAPH. As each tutorial covers an individual program module, and this table of contents shows each sub-topic within a tutorial, you will find that you are quickly able to find any given command or topic quite easily.

The Reference Guide is designed to provide a secondary source of concise information on each of the major functions within the program. You will also find that almost every possible B/GRAPH command is noted on the on-screen menus, which can always be recalled by pressing OPTION while a graph or chart is displayed.

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INTRODUCTION

B/GRAPH is a professional graphics-charting and statistical analysis program for Atari personal computers. It was designed to be used by individuals in sales, marketing, administration, forecasting and general management as well as in home and small business applications. Educators, students and hobbyists will also find B/GRAPH to be of great utility in a wide variety of applications.

B/GRAPH allows the creation of numerous types of graphs and charts, as well as providing statistical and analytical tools for the evaluation of data.

B/GRAPH is not only a powerful tool with a great number of user options, but is also very simple to use for the beginner. More than one year in development, B/GRAPH consists of 10 integrated, easy to master program modules.

This manual consists of a number of comprehensive tutorials, designed to allow you to quickly learn how to use the program package and each individual program module. Each is a step by step, hands-on course that will take you through each module, explaining every function and option. Each lesson is illustrated with actual pictures of what will appear on your TV screen or monitor. This is especially useful if you will be studying the manual away from the computer.

Included is a short course in data analysis and statistics. The analytical and statistical tools available in B/GRAPH are designed for use by individuals without any prior training or expertise in this area. Although by no means intended as a replacement for formal training or individual study in statistical analysis, this chapter will provide sufficient background in basic statistical and data analysis concepts to enable the beginner to use the programs in B/GRAPH. Of course for those who simply wish to use the extensive graphing and charting capabilities of B/GRAPH, the statistics tutorial and associated program modules may be placed aside for the time being. A bibliography and suggested reading list is provided for those who wish to explore this area further.

The Quick Reference Manual is designed to explain the major keystroke functions in each module. Combined with the on screen menus, it will allow those in a hurry to get started to do so without having to spend a great deal of time reading the comprehensive tutorials. The table of contents will also be found to be quite handy in finding where any given Function is explained in detail.

It is the intention of the program authors to not only provide on-going support and assistance to registered B/GRAPH owners, but also to continue to enhance and refine the B/GRAPH program and provide specialized program modules in the future.

We greatly appreciate your purchase of B/GRAPH and welcome your comments and criticisms. Please take a moment now to fill out and return the enclosed owner registration card. This is the only method by which we can determine that you are an authorized, registered user of B/GRAPH and thus eligable for both assistance and revisions, and updates as they become available.

Batteries Included
Toronto

SPECIFICATIONS AND SYSTEM REQUIREMENTS

B/GRAPH is designed to be used with Atari Personal Computers. Minimum memory requirements are 48K RAM. It may be used with any Atari 400, 600XL, 800, 800XL, or 1200XL, which has sufficient memory. Atari 8K BASIC is also required on models without BASIC built in. B/GRAPH does not work with Microsoft BASIC.

Either a black & white or color television or monitor may be used. B/GRAPH makes extensive use of the Atari computer's color capabilities and thus the use of a color TV or monitor is strongly recommended.

A single density disk drive, able to operate under Atari DOS 2.0, or equivalent, is also required. Use of a second drive is optional, although recommended.

All commands and data input are entered via the keyboard. Some program modules, such as Imaging Show and Custom Labeling optionally allow the use of a joystick plugged into port #0 (the leftmost port on the Atari 400 and 800) for sequencing and cursor control. Use of a joystick is optional but recommended.

All graphs, charts and data screens created with B/GRAPH may be dumped to an appropriate graphics printer. Use of a printer is optional and lack of a printer in no way restricts the usefulness of other B/GRAPH capabilities.

Printers supported include . . .
CENTRONICS
EPSON MX-RX/GEMINI
EPSON FX
C.ITOH/NEC/PROWRITER
SEIKOSHA AT/100
OKIDATA 92

Specific models from these manufacturers must have graphics capabilities or be equipped with graphics hardware modifications as required. Software for printer screen dumps, with the printers listed above, is built into the B/GRAPH program. Please check with your dealer for printer suitabil-

ity and test that your current or anticipated printer is supported by the current version of B/GRAPH. Please also note that associated printer interface devices such as the Atari 850 may also be required.

Please contact BATTERIES INCLUDED if you have or anticipate purchasing a printer other than those listed above. It may already be compatible with one of the currently supported printers or support already under development.

It is the intention of the program authors to make printer support modules available for new printers and plotters once they become generally available and widely distributed. As the printer market is currently in a rapid state of develcpment, we cannot guarantee that we will be able to provide support for all manufacturers and models. Registered owners of B/GRAPH will be advised from time to time as new printers and plotters are supported. Please advise us of your requirements.

During the development of B/GRAPH the authors used the FASTCHIP from Newell Industries, Plano Texas. This chip replaces the floating point math integrated circuit chip on the opeating system board of the Atari 400/800. The FASTCHIP allows a speed increase of from 30-50% on many computer operations such as those which use the transcendental functions — SQR, SIN, COS — and all plotting and drawing routines. It will work with the complete Newell Operating System Board as well.

We recommend the use of the Newell FASTCHIP (with 400 and 800 models) since it will substantially speed up many of the routines in B/GRAPH which are currently limited in execution speed by the Atari computer's operating system.

When using B/GRAPH for the first time, you may notice that the screen colors start out green and slowly, over the first 10 minutes or so of use, change through brown to the final dark orange color with light yellow lettering. This only occurs on certain models and only when the computer is first turned on. This anomaly is due to a previously undocumented 'bug' in the Atari's graphics controler chip that causes COLOR 15 to become unstable in hue during warm up.

We have decided to retain the use of this color nevertheless since it doesn't occur on all

models, and since the deep orange color with light yellow letters has been found in European studies, to cause minimum eye fatigue.

In order to use this program to its fullest,you will need to save your graphs, images and data to disk frequently. We suggest that you have at hand a supply of formatted disks for this purpose. You cannot save your data or graphs to the B/GRAPH disks, since they are write protected.

BASIC XL AND DOS XL

In 1984 Optimized Systems Software Inc., brought out a new more powerful version of BASIC for the Atari called BASIC XL. DOS XL, a variation on their previous OSA DOS has also been recently released. It is possible to use these two products together with B/GRAPH and gain a considerable speed increase in many functions. Here's how.

Insert the BASIC XL cartridge and boot a disk containing DOS XL. If you have an Atari XL computer you may also have to hold down the OPTION key while booting (this depends on the version of BASIC XL which you are running). Now insert B/GRAPH Disk #1 and at the BASIC 'READY' prompt, type **RUN "D:START"**.

B/GRAPH will now load as usual and due to the 'fast' pre-compile capability of BASIC XL, many functions including graphing will be speeded up by approximately 25%. Please note that you must use BASIC XL and DOS XL together for any of this to work or offer any advantage. BASIC XL by itself will not work with B/GRAPH, nor will DOS XL alone!

FOREWORD

ABOUT GRAPHS

Graphs are aids to understanding. They exist in many forms, but they all share the common characteristic that they are diagrams that illustrate information. Many people are uncomfortable when presented with several columns of numbers and asked to understand and analyse them for patterns, relationships, or trends. By wisely selecting the best graph form, the designer of a graph can translate the desired information to a readable form and help the reader to understand the significance of the information. The graph, therefore, is a pictorial communication device. The same criteria apply whether the graphic information concerns the federal budget, divisional sales performance, or the historic on-base performance of a free agent baseball player.

There are various kinds of graphs. The reason for diversity is that different kinds of situations and information require different modes of presentation. The same could be said for using a sonata rather than a concerto when expressing a musical idea. A few of the popular graph types are line, bar, and pie. There are several names for each of these. Every field has its jargon, and graphing is no exception. We will refer to the above as they are in popular use. The line graph, probably the most common, will be used to establish the basic terminology and common aspects of graphs.

WHY USE THEM?

Graphs are used to present selected information in a palatable form. It is unlikely that the graph maker will show all available information pertaining to a particular subject. Rather, highlights are usually selected which support the author's points. For example, if your division has been steadily increasing its profits, the rising line on a graph is the standard shorthand for this. The image of a rising line has greater significance for most people than a long list of numbers, even if they are generally increasing as the reader scans down the column. The baseball slugger might point to

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a similarly rising line which represents his home run production over the last few seasons. The implication for the reader is that the trend is ever increasing, very desirable in both of the above situations.

Graphs can illustrate relationships not previously noticed. A regular decrease in sales at the end of each quarter could be apparent on a graph while all but unnoticeable as a series of numbers. If nothing else, the well done graph can maintain interest in a presentation while a list of numbers could result in the opposite effect. If the time available for presentation is limited, a pictorial display of the data is a speedy means of communication.

These reasons share the major strength of graphs: they facilitate communication.

TYPES OF GRAPHS

LINE GRAPHS

The line graph is the most commonly used graph because of its simplicity. It is essentially a series of connected points. This type will be used to illustrate the common features of popular graphs. The graph below illustrates the yearly homicide rate of a fictitious city over a period of years. See figure 1.

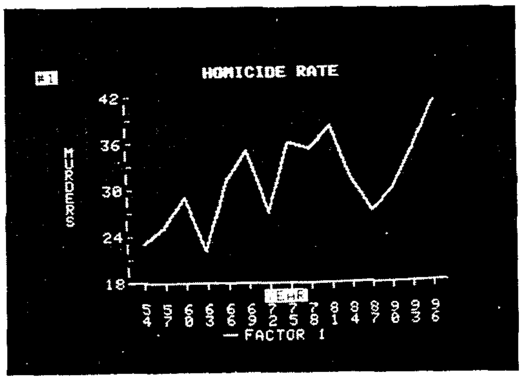


FIGURE 1

The first impression is that the rate increases fairly steadily from 1954 to 1982 and then decreases for a few years. At the end of the time interval shown, the mid 1990's, the trend shows sign of again increasing. Most people would have little difficulty in coming to roughly the same conclusion from the graph even though they may see next to nothing in a table of years and number of homicides. The graph tells a very quick story.

An examination of the above figure will provide the structural details of this family of graphs.

Title — HOMICIDE RATE is a concise summary of what the graph is about. The reader knows what information to expect.

Labels — YEAR tells the reader that time is increasing as the graph line moves to the right. MURDERS increases as the line moves up. These are conventions — values increase as the graph moves up and to the right. It does not have to be this way but it has been generally done this way for a long time and confusion is avoided by continuing the tradition. The fact that years are along the horizontal line tells us that the homicide rate depends on which year is looked at. Given a.year, the graph provides a rate. This is sometimes known as a 'time series'. Statisticians like that term. Most of the graphs examined here will be time series — they are very popular in business.

An example of a graph which is not a time series is the result of measuring the temperature of the atmosphere as the altitude increases. The horizontal axis would be altitude while the vertical axis temperature.

Along the axes, in addition to the labels, are numbers and short lines — tick marks. These symbols enable the reader to retrieve precise quantitative information. For example, how many murders were committed in 1978? Not all graphs display numbers along the axes. The demand — supply curves in economic textbooks include labels without numbers since they qualitatively show a certain behaviour — in this case the intersection of two lines resulting in a selling price. The graphs in this discussion, however, are all quantitative.

There is a subjective aspect to quantitative graphs: the notion of scale. What numbers are to be shown on the axes. In time series graphs, the horizontal scale includes the time intervals being

examined — the days, months, years, or periods. Generally, show all numbers unless they result in overcrowding. In that case, show regularly spaced intervals. The values must be easily read. That is the point of the exercise. Tick marks make it easier for the eye to identify particular values of the scale.

On the vertical axis, the ranges can be anything, under 60 murders, $100 billion to $400 billion, 15% to 97%, etc. The best scale is sometimes a matter of deciding which delivers the desired impact, hopefully without misleading the reader. Since space is always limited, it is generally best to use as much of it as possible. Showing a scale of 0 to 100 on the HOMICIDE graph would mean showing more white space and compressing the line since the space on the page remains the same. It would perhaps be justified if other graphs were being compared which went to 100. To minimize the chance of misrepresentation, it is frequently desirable to include zero as a base. This gives the reader a point of reference. It may, however, not be a concern and provide more hindrance to communication than help. A stock trading in the 88-91 range falls into this category.

The actual numbers shown on the scale should be easy to read. Numbers that are even, ending in zeros or that are meaningful gradations for the particular situation are preferred. Because the best scale depends on what the purpose of the graph is, it is desirable to be able to modify it when necessary, as B/GRAPH permits.

The Line Itself

Based on the data, the axes and scales are established so that the data points can be plotted. The line graph simply connects these points. The result is a line which is really the sum of small line segments between each successive pair of points. On a dot matrix printer, the lines are only as reliable as the resolution (dots per square inch). For most applications, the popular printers are more than adequate. The proviso is most relevant when a great deal a rapidly varying data is included in one graph. Plotters suffer less from this problem.

The plotted points which the lines connect can be dots or other symbols which are more pronounced. B/GRAPH allows the 'x', 'o', and '+' for this purpose. See figure 2.

FIGURE 2

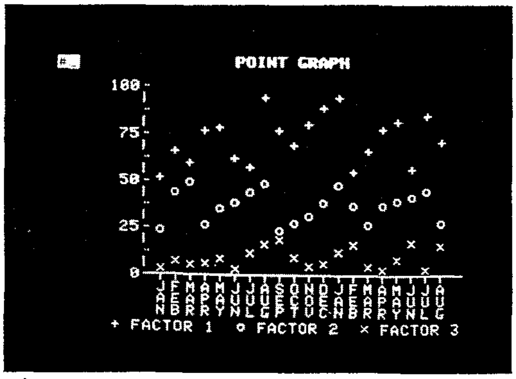
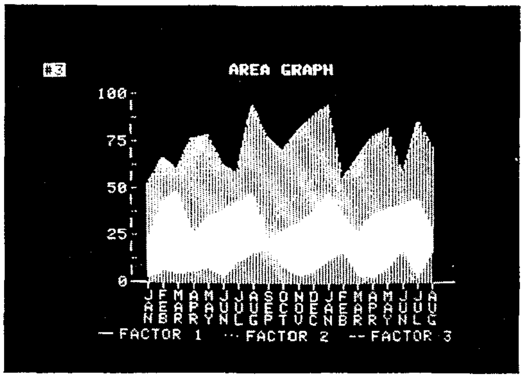


FIGURE 3



Using different symbols is necessary when plotting more than one factor on the same graph. Say, for example, that homicide rates for two different cities are shown on the same graph. Through different symbols for the data points or different line markings, the comparison is effectively made.

The component-part, or area, graph, can show totals and highlight constitutent contributions. In the multiple factor graph above, each line uses the same horizontal axis for its base line. In the area graph, each factor line serves both as its contribution and the total to that point as well as the base line for the next factor. The successive components are seen as layered areas.

The line of the uppermost factor represents, then, the boundary for its contribution and the total of all the factors. See figure 3.

A distinctive fill pattern or color, as in B/GRAPH, can strikingly demonstrate how one component is tending to become more significant. An area graph of computer sales versus time showing main frames, minis, and micros would highlight the extraordinary growth of the micro.

More Extensions To The Basic Line Graph

Multiple factors described above are just one extension to the simplest line graph. To aid the eye in reading values of the graph, lines parallel to the axes, a grid, can be drawn. See figure 4.

Since these grid lines pass through the area in which the graph is drawn, confusion may result. Again, while this facility is sometimes helpful and is supported by B/GRAPH, it's effect should be evaluated in any possible application. If the graph gets too busy, the aim of the graph, communication, may be lessened.

FIGURE 4

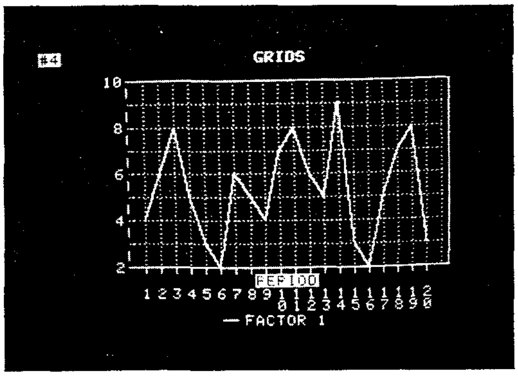
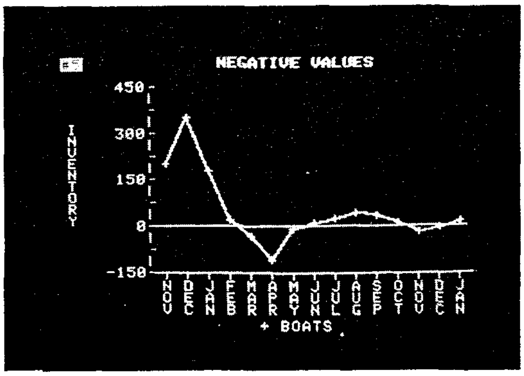


FIGURE 5



Another extension of the line graph is extending the vertical axis beneath the horizontal axis. See figure 5.

Since the horizontal axis usually represents zero, this extension allows for negative values of the vertical coordinate. Losses are commonly expressed this way. The horizontal axis is then not at the bottom of the graph and the scale includes negative as well as positive numbers. The other considerations apply as before.

One last 'extension' will be mentioned in this discussion of line graphs, and that is not having the line at all. If it is not desired to connect the points, giving the reader the freedom to relate the points as he wishes, only the points are plotted. Connecting those points can imply information about the intermediate values that is unjustified. Daily Dow-Jones Industrial closing averages miss the day's variations. For some applications, this is an important omission. B/GRAPH allows connecting between up to three sets of data points as a changeable option.

BAR CHARTS

A popular format that displays the same data as the line graph is the bar chart. It is constructed by drawing a thicker line, or bar, from the data point to the horizontal axis. The HOMICIDE graph below is a three-dimensional bar chart illustrating the same information as the graph earlier, but in bar form. Notice the different effect produced by changing forms. See figure 6.

FIGURE 6

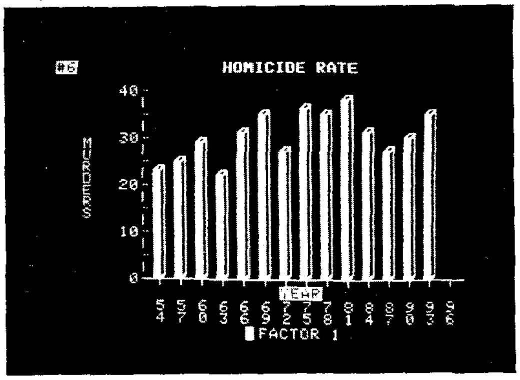
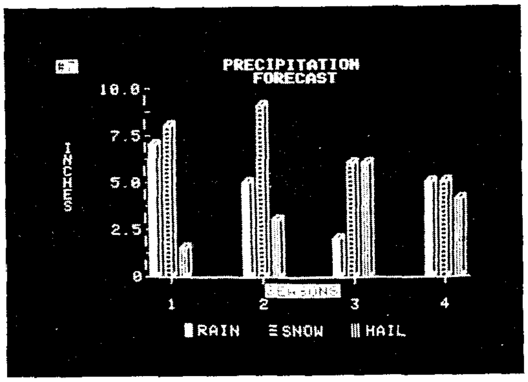


FIGURE 7



One reason for using the bar chart is its visual impact. Compared with the line graph, which demonstrates variation of strongly related quantities, the bar chart is particularly effective when

contrasting different entities: departments, regions, crops, etc.

Combining multiple factors in one bar chart can further aid presentation. In the figure above, precipitation is broken down into rain, snow, and hail by season. See figure 7.

The bar, rather than the data point, suggests the depth of the precipitation. The use of different markings for the three precipitation types allows the reader to see variation by season as well as by precipitation type. In effect, this two-dimensional graph simulates three dimensions. This technique does not, however, lend itself to detailed trend analysis. The bars are discrete rather than the continuous data display of the line graphs. As always the application and personal taste dictate the appropriate presentation mode.

More Bar Chart Variations

The figure below illustrates negative values on bar charts. See figure 8.

In this case one to three of the factors can be negative or positive.

FIGURE 8

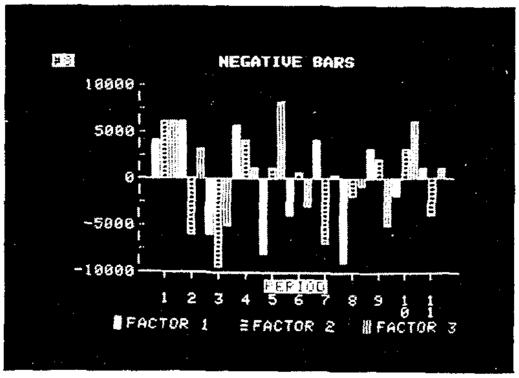
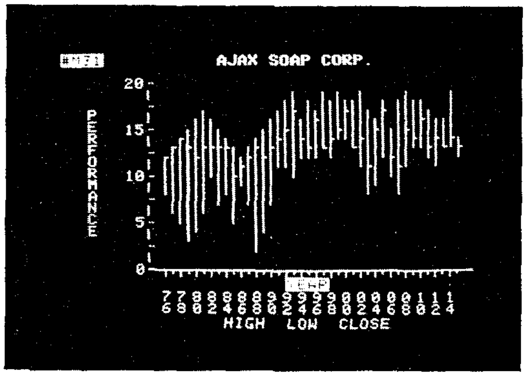


FIGURE 9



A variation seen on the financial pages is the high-low-close chart. As its name indicates, the bar extends from the instrument (stock, option, commodity, etc) high to its low. The low in general does not touch the horizontal axis. The third of three factors is the closing price which is normally indicated as a short horizontal line extending to the right from the bar. Each bar can represent any chosen time period. See figure 9.

Another popular bar chart is the component type. On each bar, the different factors are shown, one above the other, in different design. The chart below shows three factors. See figure 10.

The component bar chart is used when it is desired to demonstrate the total of several factors as well as the factor contributions. The rain-snow-hail information now combines to show total precipitation — something not easily ascertained in the multiple factor bar chart. The trade-off is that the second and third factors, easily compared earlier, are now more difficult to extract. Again, it is a question of what the reader is expected to extract from the graph.

One technical point. Strictly speaking, the vertical bars are called columns. Common useage, however, has made bar chart, or Histogram, acceptable in most situations.

FIGURE 10

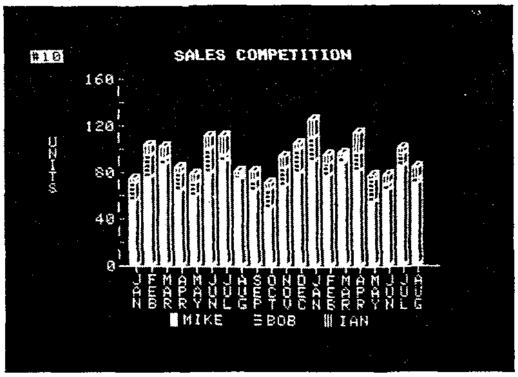
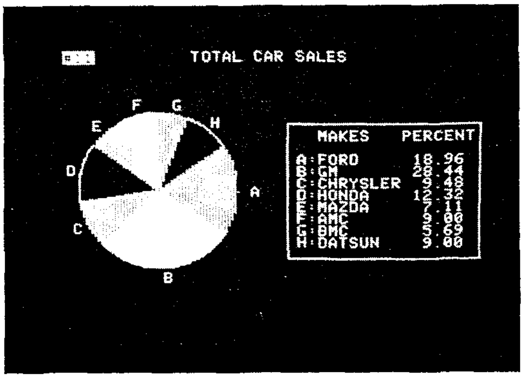


FIGURE 11



PIE CHARTS

The pie, or circle chart, is frequently used to show how some quantity, the 'pie', is apportioned. Percentages are frequently illustrated this way. See figure 11.

By glancing at the pie, the reader can see that GM has the largest slice of this imaginary pie. Ford and GM together represent about half the sales. The precise breakdown is shown at the right indicating that those two car makers total 47.4%. The technique is understood by noting that a circle has 360 degrees. A particular percentage is illustrated as that fraction of a full circle.

Perhaps the most effective use for the pie chart is the "Where Your Tax Dollar Goes" chart consisting of a representation of a dollar coin broken down by percentage which translates into cents. The reader derives a sense of pleasure or discomfort in learning how many cents of his tax dollar go to a particular kind of expenditure. This information can be displayed using the other techniques described above, but, for taxes, the pie seems to strike an effective chord. And that is what graphs are all about.

Written by
Stephan Kogitz PHD
Toronto, Ont. Canada
1983

B/GRAPH TUTORIAL

GETTING STARTED

Before proceeding, please read the section of this manual entitled "Specification and System Requirements". This explains the minimum memory and equipment requirements for B/GRAPH as well as optional equipment that may be used.

We strongly recommend that first time users of B/GRAPH work through this tutorial on their Atari computer. This is the most efficient way of becoming familiar with all of the features and capabilities of the B/GRAPH program. It is also possible for you to become acquainted with B/GRAPH through the Reference Manual section. One important thing to remember while using B/GRAPH is that you can always press the **OPTION** key to return to a menu if you forget what you're doing or need to do next. You will NOT lose your graph or data by returning to the menu; pressing **R** will always redisplay the graph or, in the Statistics programs, **B** will allow you to browse your data. Data or graphs are never lost until you load in other files or exit to another program without saving your data. Even then, you will be asked if you wish to save your data before exiting. Remembers: *YOU DO NOT LOSE DATA BY PRESSING OPTION.*

You will note that we use bold face names such as **START** and characters such as **S** or Display in the tutorial. For the most part, this represents a key command on the Atari. When you are looking for references to specific keys or commands, this will help you locate them on the page. Wherever possible in B/GRAPH, we have made all commands single keystroke entries to facilitate ease of use.

A note regarding BREAK and RESET.
To avoid inadvertent loss of program control or your data, the BREAK key has been disabled. There is a standard method of moving from one program module to another, as well as performing tasks while a graphics screen is displayed. These are discussed in detail throughout this manual. The BREAK key is NOT one of these ways

SYSTEM RESET on the Atari is a well-protected key and in normal circumstances will not be pressed accidentally. If it is pressed, either accidentally or intentionally at any time during the operation of B/GRAPH, the Atari will do a "cold start" which is equivalent to rebooting the disk by turning your computer off and on again. If B/GRAPH disk #1 is present in drive 1, or the only drive, the printer selection menu will be displayed. If any other disk is present it will either be

'booted', or the system may 'crash'. In any event, any data present in memory when **SYSTEM RESET** was pressed will be lost! To resume operation, reboot disk #1 from the beginning as if you were starting a new session with the program, by turning off your Atari, and then turning it on again after 5 seconds, with B/GRAPH disk #1 in drive 1.

The source code to B/GRAPH is proprietary, copyrighted and cannot be displayed or listed. Please respect our copyright, and our effort in creating B/GRAPH by not attempting to do so or by attempting to copy these disks for any use. Thank you!

POWERING UP

Turn on your Atari 810 (1050) or other compatible single density disk drive. After the disk has stopped spinning and the top red light on the 810 disk drive has extinguished itself, insert B/GRAPH disk #1. Ensure that your TV or monitor is turned on at this time and that Atari BASIC is installed. Turn on your computer. After approximately 20 seconds, the initial program will have loaded and the Printer Selection Menu will appear. This screen is reproduced as FIG 1.

PRINTER SELECTION MENU

If you have one of the printers indicated, turn on your Atari 850 interface (if required) and your printer. For a discussion of printer compatibility, please read the Specification and System Requirements.

Even if you do not have a printer, or do not wish to use it, you still MUST press one of the selection numbers to proceed. It does not matter in that case which one is selected, just press any valid number to proceed.

Select your printer by pressing the appropriate number. It is not necessary to press **RETURN**. The disk drive will now start up again, and a second program module, the "Program Selection Menu" will shortly appear. This menu is reproduced below as FIG 2. You will find that you can return to this menu from any of the other program modules at any time. If a disk change is required, you will be informed of this on the screen at the appropriate time.

FIGURE 1

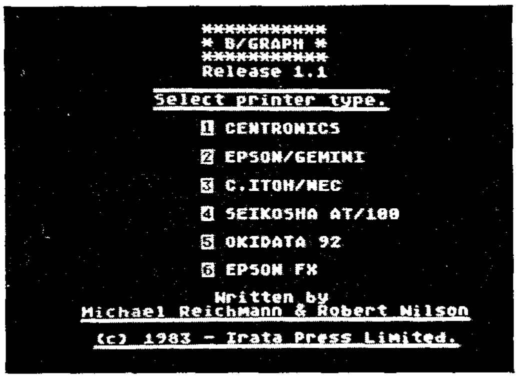
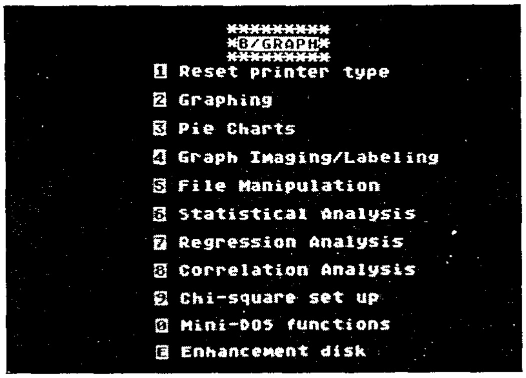


FIGURE 2



PROGRAM SELECTION MENU

See FIG 2

RESET PRINTER TYPE

This option will return to the Printer Selection Menu. It is unlikely that after initial start-up and printer selection that this will be required again, but in the event that you have inadvertently chosen the wrong printer or wish to change printers in mid session, you may return to the Printer Selection Menu via this option.

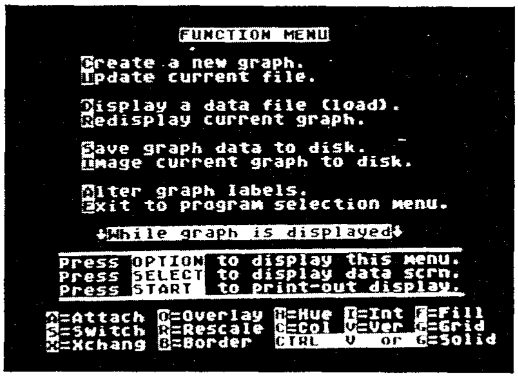
Press 1 and return to the Printer Selection Menu to see how this works. After the Printer Selection Menu has displayed again, select your printer choice and return to the program selection menu.

GRAPHING

Selection #2 will load B/GRAPH's main graphing module. This module permits the creation of Bar Graphs, 3-D Bar Graphs, Segmented Bar Graphs, Line Graphs, Scatter Graphs and Market Graphs. It also provides a wide variety of customization routines, including Grids, Overlays and Rescaling; selection of Color, Hue and Intensity; Printer Dumps, Graph Imaging, Data File Retrieval and more. All of these capabilities are explained in detail as they are encountered in this section of the tutorial, and may also be found in the reference section of this manual.

At this time press 2. The disk drive will start up and after a short while the GRAPH FUNCTION menu will be displayed. A reproduction of this screen is printed as FIG 3.

FIGURE 3



GRAPH FUNCTION MENU

Take a moment now to study this menu. It is similar in form to all B/GRAPH menus. You will find that where possible, similar or identical commands are used in all B/GRAPH program modules.

The first thing to note is that the menu screen is divided into an upper and a lower half. The

eight inverse letters in the top half of the screen — **C,U,D,R,S,I,A** and **E** — are single keystroke commands that will execute B/GRAPH functions while this menu is displayed. Do not press any of them at this time. Also note that when making one of these selections, you do not need to press **RETURN**, or the **ATARI** Key (the logo key at the lower right on the keyboard) for inverse. The command letters are in inverse on all B/GRAPH menus, simply for clarity.

The lower half of the menu screen is separated by a line of inverse text which reads . . .

—While graph is displayed—

The commands below this line are appropriate and active only while a graph is displayed on the screen. You will have a chance to experiment with and learn all of them shortly. They are on the Main Function Menu simply as a reminder, for your convenience, though a few of the less common commands aren't indicated.

Note particularly the line which reads; "Press OPTION to display this menu". At any time while a graph is on display, pressing the OPTION key will return you to this Function Menu. As you will soon see, the graph displayed will not be lost and may be instantly redisplayed, so that you always have access to this menu screen as a reminder of the functions available.

DISPLAYING A GRAPH (LOADING)

We will now retrieve a demonstration graph from disk #2. Please remove disk #1 and insert disk #2 into your disk drive.

Those with special DOS applications should note that the Image Show module is transportable and may be used under any DOS. Complete information on this is contained in that section of the tutorial.

It is sometimes necessary for single drive users to remove a B/GRAPH program disk and insert a data disk to retrieve graph data or Images. If you are using a second drive, simply leave your B/GRAPH program disk in drive #1, and place the designated data disk in drive #2. Some of the statistical analysis modules are contained on B/GRAPH disk #2. When requested, this disk MUST be inserted into drive #1 even on a two drive system.

Special Note to owners of 2 Drives
This tutorial and manual assumes that you have one disk drive. B/GRAPH and each of it's program modules are able to support two drives. To avoid making this manual awkward and difficult to read, we have written it under the assumption that only one drive will be used.

With two drives, when a file name is requested for either input or output, simply type **D2:filename.** B/GRAPH file function inputs do not require the form **D:filename** or **D1:filename** but will accept as well simply '**filename**' by itself. Naturally **D2:filename** IS required if you are using a second drive.

Disk #2 contains several B/GRAPH program modules, but for your convenience in working through this tutorial it also contains several demo graph files. You will not be able to write files back to this diskette since it is protected against accidental erasure with a 'write protect' tab. Please do not remove this tab; you might then accidently erase one of the B/GRAPH program modules. Removal of the write protect tab will also void your program warranty.

FIGURE 4



With disk #2 installed in your disk drive, press **D** for Display Data File. Your screen will now display the B/GRAPH Data Directory Menu. This is reproduced as FIG 4.

You will see the line "Last File was . . .".

At this time this line will not have a file name after it as no file has yet been selected. The next time you return to this menu to retrieve or save a file, it will display the name of the last file saved or loaded. This is valuable information in the event that you wish to resave an updated file under the same file name, but have forgotten what it was originally called. Every B/GRAPH program module will inform you of the name of the last disk file in a similar manner. This information is also retained between program modules to assist you in performing a range of functions on a single file without having to double check its name each time.

VIEWING THE DIRECTORY

To see the disk directory — the names of all the files on the disk and how much space remains for additional files — simply press **RETURN**, rather than typing a file name at this time. Those users with two drives who wish to see the directory for drive #2 should press **2** followed by **RETURN**. A **RETURN** by itself always gives the directory for drive #1.

The disk will now be read and a directory of file names is displayed along with the number of free sectors available on that disk. An illustration of this screen display is given in FIG 5.

As indicated at the bottom of the directory screen, pressing the **ESC** key at this time will abort the directory function and return you to the Main Graph Function Menu. **RETURN** will take you to the file input screen again so that a file may be loaded. Press **RETURN** now.

Practice moving back and forth between the **D** command in the Graph Function Menu and using **ESC** to abort a directory read. When you are comfortable with navigating between these three functions return to the display of the file input screen.

LOADING A DATA FILE

You may have noticed that one of the files listed on disk #2 was titled DEMO1.DAT. We will now load that file for display. The cursor is resting just after the line 'File name:' Type **DEMO1.DAT**. You may enter file names with or without 'D:filename' or 'D1:filename'. B/GRAPH is happy to ac-

cept any of the three forms. Use whichever you find easiest. Users with a second drive will of course want to type **D2:DEMO1.DAT**. If you make a typing error while entering the file name you may use the **DELETE BACKSPACE** key to make a correction. Now press **RETURN**.

If you have accidentally entered an invalid file name, or the file name entered does not exist on the disk being read, you will simply be returned to the File Input Screen. Please note that it is possible to accidently hit the **ATARI KEY** or the **CAPS/LOWR** key. These have not been permanently disabled, since you may wish to use inverse or lowercase in various parts of the program, particularly when doing graph labeling. When typing a file name you MUST make sure that you are in UPPER CASE NON-INVERSE text. On the other hand, in parts of B/GRAPH that expect single key responses, such as menu selections, lower case and inverse are automatically reset for you.

FIGURE 5

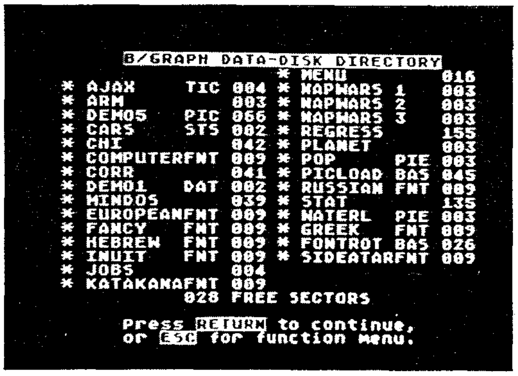
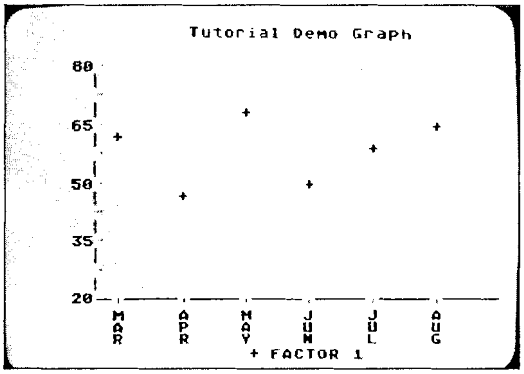


FIGURE 6



The file DEMO1.DAT will now be loaded and in a few seconds the graph will be displayed on the screen exactly as it was Saved to disk (explained later). The graph is a single factor, scatter (point) graph, with SIX data points, IE; SIX months worth of data. Take a moment and examine the

graph in detail. If you are using a color TV or monitor the background will appear black and the lines and text in white. This is normal and you will be shown how to change all screen display parameters in a moment.

As we noted earlier, pressing **OPTION** will return you to the Graph Function Menu while a graph is being displayed. Test this by pressing the **OPTION** key now.

RE-DISPLAYING A GRAPH

You will find yourself back at the Function Menu. To redisplay the graph, simply press **R** as noted on the menu. The graph that was previously displayed will be instantly redisplayed. Notice that the bottom few lines of the screen are NOT instantly redisplayed and that the program takes a second or so to redraw them. This is due to the nature of Atari screen memory management and is unavoidable given the size of this program module. It is hoped that future releases of B/GRAPH designed for the next generation of Atari computers with more than 48K of memory will allow this minor inconvenience to be programmed out.

Practice using **OPTION** and **R** to move back and forth between the displayed graph and the Function Menu. Also while in the Menu screen, try using the **D** command to look at the disk directory, and then use **ESC** to abort that function and return first to the menu, and then use **R** to Redisplaying the graph.

Nothing other than Creating a new graph, Displaying another data file, or Exiting the program module will cause you to lose your graph data or destroy the graphic screen.

DISPLAYING THE SECOND (DATA) SCREEN

With the demo graph displayed, press **SELECT**. This displays the data that was used to create the graph, in tabular form. You may use **SELECT** to display this second screen at any time while a graph is being displayed. If there are more than 20 data points in the graph, pressing **P** while the screen is displayed will display the additional data. Since B/GRAPH can handle up to 100 data points in each of three factors, you would press **P** five times (5 × 20) to view all the data for such a graph. In our example graph, with less than 20 data points and therefore only one screen, press-

ing **P** simply redisplays the current screen. **B** will move you backwards a screen at a time if there are multiple data screens.

As noted on the screen display, you may press **OPTION** at any time while in the second Data Screen to return to the main Function Menu. Practice moving back and forth between a graph display and the Data Screen by pressing **SELECT**. Remember that once you have returned from the Data Screen to the Function Screen by pressing **OPTION** you may Redisplay the graph by pressing **R**.

PRINTING GRAPHS

The third special function key mentioned on the Function Menu is the **START** key. This is used to print out a displayed graph. If you have a B/GRAPH compatible printer, (Please see Specification and System Requirements) and you haven't yet turned on your Atari 850 interface and printer do so now. If you do not own a printer, you may of course skip forward to the next chapter of this tutorial, as this discussion is solely about printer dumps. If you attempt to print a graph without a printer attached or online, an error will result and you will remain at your display screen and nothing will happen.

While a graph is displayed on the screen, you may press **START** and the graph will be dumped to the printer. Make sure that your printer is switched to 'On line' and press **START** now. The dump will usually take less than a minute, depending on the printer that you are using.

Our experience has shown that ALL graphics printers have a hard time printing multiple columns of vertical lines. If you are having difficulty in that area here are two suggestions. First, use the heaviest paper that your printer will accept. The paper then tends to 'creep' less when being hit by the printer head and thus lines will be straighter. The second suggestion is to put a heavy typewriter pad under your printer. The reduced vibration also tends to lessen paper creep.

If your printer and/or interface are not turned on, or you press **START** without a printer attached, nothing will happen. If your printer IS turned on and nothing happens, it means that B/GRAPH doesn't like something about your set up. Problems may include your not having selected

the correct printer type on program start up, the interface not being turned on, your printer not being on, or in the Off Line or Local position. If all of the proper conditions are met, try booting another program that you know DOES make your printer work.

We have extensively tested B/GRAPH with all printer combinations, but if you still have a problem, call us on our 'Hot Line' and we will do our best to help.

During the printer dump, none of the keys on the computer will respond. This was done to protect the print routine and to insure a good print copy. However, once the printout is completed, you will be able to press any of the normal command keys and proceed to another function, or press **START** again for another printout.

The use of a printer buffer is recommended if you are planning on producing a large number of printouts. Our screen dump routine is quite fast and, depending on the printer you use, a buffer can allow you to proceed before the first quarter of your graph has been printed out.

PRINTING THE SECOND SCREEN

You may also print out the second (data) display screen. To do this, press **SELECT** to display the second screen and then **START**. If your graph has more than 20 data points, after the first screen had printed out you would then press P and then press **START** to print out each subsequent screen.

If you had any difficulty doing a graph printer dump, try doing a printout of a data screen. This is not a high-res (GR.8) screen dump using B/GRAPH's proprietary screen dump routine, but a straight text mode (GR.0) printout. If this works normally but the graph dump does not, then it is possible that your printer is not capable of using our graphics print routine. Please make sure that your printer is one of those currently supported by B/GRAPH.

One final word on screen dumps. Although we haven't explored it yet in this tutorial, you will be able to change all of the screen color, hue and intensity parameters of which the Atari is capable. In other words, instead of the light text on a dark background that is B/GRAPH's default, you may set dark text on a light background, using almost all of the color, hue and intensity

combinations of which the Atari is capable. Regardless of what combination of intensity or color you have set it will always be printed out as black lines on a white background. We also suggest that a new ribbon produces the best looking graphs and is very important if the graphs you are going to produce are to be photocopied. The darker the original, the better.

CUSTOM SCREEN DUMPS

B/GRAPH has a very versatile built in printer dump capability that supports most of the popular graphics printers on the market. Nevertheless, there are new printers being introduced almost every week, and some of these may not be compatible with our screen dump routine. Also, some users may find that they have need for printouts of different sizes, shading or other parameters. In a later chapter we will examine how you are able to save graphs and charts created with B/GRAPH as both data files and as graphic screens. We call the latter either PICTURE files or IMAGES. Both graphs and IMAGES may be printed out as described above with our built in dump capabilities or with the following technique if that is preferred.

You will find on B/GRAPH Disk #2 a BASIC program named PICLOAD.BAS. This program may be copied to any other disk and does not require any other B/GRAPH program to load it. This program will simply load and display any PICTURE file (IMAGE) created with any of the B/GRAPH modules. You may thus use it with almost any screen dump utility program so that custom printer dumps may be performed.

To use PICLOAD.BAS simply load up your screen dump utility and then RUN"D:PICLOAD.BAS. Follow the directions for performing screen dumps that accompany your screen printout utility program. It may be copied freely, thus, if you wanted to allow a friend or associate the ability of displaying B/GRAPH Images, you could give him/her a disk containing several IMAGES and a copy of PICLOAD.BAS.

The only limitation that we are currently aware of regarding use of third party screen dump utilities, is that PICLOAD.BAS will not work with any program that is in the form of a right cartridge for the Atari 800. Unfortunately there are memory configuration conflicts between the programs.

SAVING A GRAPH DATA FILE

Before we experiment further with our current graph and learn how to Update and Switch graph types, we will see how to Save a graph to disk as a data file. If you do not have the GRAPH FUNCTION on screen, press **OPTION** now.

Press **S** and the B/GRAPH Data Directory screen will be displayed. This screen works almost identically to the Load command except that the name that you type in will be that given to the file that you wish to Save, rather than one to be Loaded. All of the comments made in the previous section regarding file names and disk drive designations apply. You may of course press **RETURN** to view a disk directory prior to making a save, and you will note that the line . . .

"Last File was . . ."

now reads DEMO1.DAT since that was the last file name accessed, if you have followed the tutorial.

Remove B/GRAPH disk #2 from your drive and insert a blank formatted disk that you intend on using for B/GRAPH files. Actually any spare disk with at least a few free sectors will do for now. B/GRAPH has a Mini-DOS module called from the Main Program Menu that allows you to perform most DOS file functions, including disk formatting. A discussion of that program module occurs later in the tutorial.

With your own data disk installed now type in the name FILE.1 and press **RETURN**. Actually any legal Atari disk file name would be acceptable, but we will be referring to this file later in this lesson and will call it by that name. After a few seconds the data that went into creating that file will have been saved, exactly as you saw it but without any grid lines (explained below). You will find yourself back at the Main Function Menu.

The information that B/GRAPH stores to disk only occupies a few disk sectors. The exact length depends on the amount of data that you enter into the file. You will be able to store up to 64 B/GRAPH data files on a disk. This limitation, by the way, is not imposed by B/GRAPH, but by the Atari's Disk Operating System which will not support more than 64 file names on a disk. If you

are saving B/GRAPH Images along with data files then you will find that a disk fills up quickly. It is a good idea to have at least one formatted disk handy at all times.

COLOR CONTROL

B/GRAPH provides you with complete control of screen Color, Hue and Intensity. If you still have DEMO1.DAT displayed from practicing printer dumps, press **OPTION** to display the FUNCTION MENU.

You will note at the very bottom of the screen the letters C, H and I. While a graph is displayed, you may press these keys to change each of the screen display parameters. Press **R** to Redisplay the graph and then press each of these keys and allow them to cycle through all of their possible combinations.

You will note that combinations which would allow the screen to become blank due to poor Hue and Intensity selection have been disabled. It is thus impossible to set up a combination that will make the screen blank, although it is very possible that you will be able to come up with a multitude of combinations that are unpleasant. Practice and experiment with **C**, **H** and **I** until you are familiar with the results produced.

EXCHANGE

While the C, H and I controls provide access to almost every color combination that your Atari is capable of, you may find that doing an 'inverse' or 180 degree hue and intensity change takes quite a few key strokes. In other words, if you had dark text on a light background and wanted light text on a dark background you would have to press H and I each six times for a total of twleve keystrokes to reverse all values.

By pressing X while a graph is displayed you can eXchange both Hue and Intensity values at any time with a single keystroke. Practice using X with different color combinations as well.

GRIDS

Return again to the Function Menu using OPTION. Remember that by doing so, you do not lose your graph or data. You will see in the bottom section two commands; Grid and Vert. Redisplay the graph and then press G. This will place a horizontal dotted grid on the screen. The Grid command will work with all types of graphs. (We will see how to change graph types shortly.)

To remove the grid, press G again. You will see that the graph is completely redrawn. The reason for this is that, on a complex graph, a grid might overwrite important data points or text and if simply erased would leave gaps on the screen. Although completely redrawing the screen adds a few seconds to the operation, it ensures that your graphs are always displayed with the utmost clarity.

To create a Vertical grid, press V. As with the G command for a horizontal dotted grid, you may "undraw" (erase) a vertical grid by pressing V a second time. You may of course combine vertical and horizontal grids on the same screen in any order.

Later on when we examine the different types of graphs which B/GRAPH can create, you will note that while a horizontal Grid can be displayed with any type of graph, a Vertical grid will only be displayed on Line Graphs and Point (Scatter) Graphs. It will not work with Bar Charts. The reason for this is simply that, since a bar chart is comprised of many vertical lines, a vertical grid would either become lost or appear confusing.

SOLID GRIDS: CTRL-V and CTRL-G

As indicated at the bottom of the main menu, CTRL-V and CTRL-G are also available. The only difference between V and CTRL-V and G and CTRL-G is that when pressed with CTRL, a solid grid line will be produced rather than a dotted one. All other rules regarding grids apply in either case.

Be aware that if you change from an already displayed dotted grid to a solid grid, the graph will not be redrawn. If you attempt to change from a solid grid to a dotted one though, you will see that the entire graph will be redrawn to avoid erasing important data. Whether you select solid or dotted vertical and horizontal grids is simply a matter of taste.

One final word on grids and screen color control. When a graph is Saved to disk as a data

file, the information on Color, Hue and Intensity is saved to the file. Grid information is NOT saved. In other words, if you call up a graph data file with the Display command, all of the color hue and intensity information will be display as it was when you saved it. But even if you had a vertical or horizontal grid displayed at the time you Saved the graph, it will not be redisplayed as the information is not saved to disk.

The reason for this is that, while either type of grid may be added virtually instantaneously, removing them takes a while since the graph must be completely redrawn. On a 100 data point, three factor graph, this delay could be annoying, so we have decided to structure the files in this manner. When saving a graphic screen as a high res Image you DO save the grids as part of the Image. This is also discussed in a later chapter.

ATTACHING POINTS

The graph that you have been working with up until now, DEMO1.DAT is what we call a Point graph. This is frequently also called a Scatter graph, but in B/GRAPH we do not use that nomenclature as we reserve the letter 'S' for a different type of graph called Segmented Bar Charts. If you are used to Scatter rather than Point, sorry.

Point graphs have associated with them one command that doesn't work with any other type of graph; Attach. If you were to press the A key while any of the other types of graphs were displayed, nothing would happen.

Return to the Function Screen and note that Attach is located at the bottom with the other commands that are available while a graph is displayed. Redisplay the graph and then press A. A solid line is instantly drawn between the points. To remove the line, simply press A a second time. The line will be erased. You may create the line and erase it as often as you wish.

Look closely at the screen when you press A the second time to erase the line. After the line is erased the '+' points are redrawn to remove the breaks where the lines crossed through them. The Attach information is Saved in a graph file and will be redisplayed when a file is called from disk. A bit later in this tutorial we will add two more factors to this graph. Factor two Data Points

will be represented by 'o' and factor three by '×'. If you do an Attach with two or three factors a dotted line will be used to connect the 'o's and a dashed line to connect the '×'s. This will be demonstrated shortly.

SWITCHING GRAPH TYPES

One of the most powerful capabilities of B/GRAPH is the ability to instantly change back and forth between graph types. To accomplish this, we use the Switch command while a graph is displayed. A reminder for the Switch command is also at the bottom of the Function Menu screen.

FIGURE 7

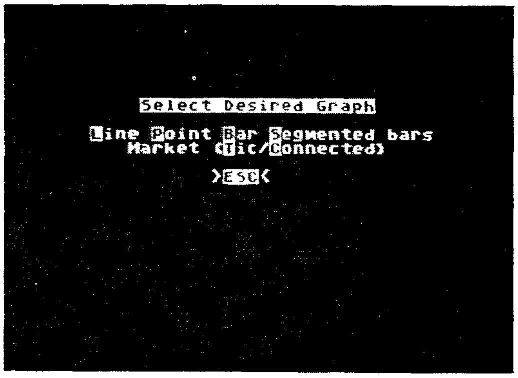
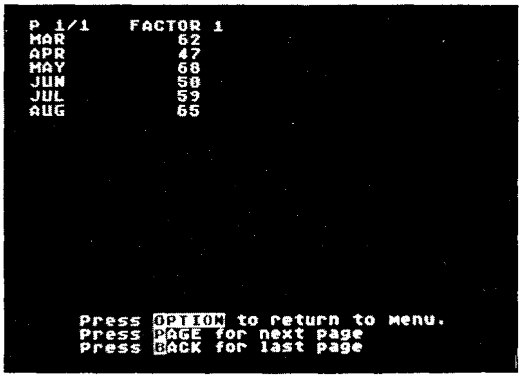


FIGURE 8



With the graph displayed (you were getting bored with it by now weren't you), press **S**. You will now see the Graph Selection Menu. Depending on the data input, not all graph types can always be displayed. For now, press **L** for a Line graph. The graph will be redrawn in the form of a line graph. Just as a test, try pressing **Attach**. It won't work, for the reasons noted above.

Press **Switch** again, and this time select **B** for a Bar graph. What you will now see displayed

is a three dimensional bar graph. At this time you may wish to experiment again with the Color, Hue, Intensity and eXchange commands. The reason for doing this is that you will note that the color of the front face of the bars is solid, but the actual color will depend on what the Color Hue and Intensity of the rest of the graph is.

When we add factors two and three you will see that factor two is displayed with a striped front face on a monitor or a second color on your TV set and factor three has a checkerboard pattern. More on this later. Just note that it is impossible for us to tell you the actual colors you will see displayed on your screen not only for the above reasons, but also because of artifacting. Please read Appendix B for a discussion of artifacting. This is a technical discussion, but may be of interest if you are curious about how your Atari works.

With only a single factor, such as we have with our current demo graph, we can not display either Segmented Bar charts or Market Graphs (T/C), so we will now learn how to Update a graph so that we can add more factors and then return to examining the different graph types.

Before moving on to the next section, take a few minutes and review all of the commands that we have covered so far.

What we have learned are the commands for Displaying a data file, using Grid, Vertical, Color, Hue, Intensity, eXchange and Attach, and then using Switch to select another graph type with Line, Point and Bar. Using OPTION for the Selection Menu, SELECT for the Second Data Screen and START for printer dumps has also been covered thus far. If you are uncertain about the use of any of these comands, please reread this chapter before proceeding.

UPDATING A GRAPH AND ADDING DATA

Although it is sometimes sufficient to enter current data and use it to create a graph or chart for a single purpose, in many instances new data must be added from time to time to an existing data file. Examples include the case of a Sales Manager who is using B/GRAPH to create monthly graphs of his sales performance; a teacher graphing student scores on weekly tests, or any other

application where you want to add new data to an existing graph at some later date. The ability to add new information is accomplished with the 'Update a current file' command. Other, more sophisticated updating and changing is done with the FILE MANIPULATION program, discussed later.

If the graph screen is displayed, return now to the Function Menu, and note that the Update command is one of the commands that is executed while the Function menu is displayed. Excepting commands such as Display, which we used to call up DEMO1.DAT from disk #2, most of the commands we have learned thus far are executed while a graph is displayed. It is important that you note the difference between these two families of commands. The Function Menu reminds you of the two groups.

Press **U** now. You will immediately see B/GRAPH's data entry screen. You will use this screen for both original data entry with the Create command and when Updating a file. We will not go into great detail at this time on all of the features available on the data entry screen, but will cover these later when we discuss Create.

Down the left hand side of the screen are displayed the names of the months. Although the file that we loaded earlier had only six data points, or items, a full twenty months are displayed. The reason for this is to allow you to add new additional data if you wish.

Across from each month name is a number. These are the numbers that were used to create the graph, and if you recall, are the same as the numbers you saw when you pressed **SELECT** to display the Second Data Screen. You can now use all of the Atari's screen editing commands to change, or add data. We assume that you are familiar with using **CTRL** and one of the four Arrow Keys together, to move the cursor and also the **INSERT** and **DELETE/BACK S** keys. You may move the cursor anywhere on the screen that you are able, to add or delete data at that location.

At this time do the following: move the cursor over the number '50' which is across from 'JUN'. Change the '5' to a '7'. 'AUG' is the last month with any data. Press the **RETURN** key repeatedly to move the cursor down so that it is across from 'SEP'. Note that **RETURN** does not overwrite anything. It merely moves the cursor down one line at a time and does not change anything that may lay under it.

With the cursor across from the word 'SEP' type in the number 48. If you make an error, use the cursor control keys to position the cursor where you want it and then type the correct data. You may also use the **SPACE BAR** to overwrite (blank out) unwanted data.

RETURN is not used to 'enter' data. It simply moves the cursor down one line. No changes made to this data entry screen are 'entered' until the screen is 'exited'. It also doesn't matter where on a line that the data is entered. The columns of numbers needn't line up.

There is a lot to learn about the data entry screen, but for the time being simply practice moving the cursor around the screen and make the one change and one addition noted above.

You will see a line at the bottom of the screen that says:

Press **ESC** to terminate entry.

Press **ESC** now. You will immediately see below it the question:

Are you sure (Y/N)?

Just to test it, press **N** to answer NO. The question will disappear, and you will once again be able to make changes or additions to the data entry screen. The cursor is automatically repositioned over the first data point. Press **ESC** again and this time answer **Y** for YES.

You will now be asked if you want 'Another factor'. For the time being type **No**. You will then be presented with the Graph Selection menu. Select **L** for the moment, and within a few seconds a graph will be redrawn that includes both the new data for the month of SEP and a value of '70' for the month of JUN whereas it previously contained '50'.

Note as well that the month SEPtember has been added to the bottom of the graph and the horizontal divisions rescaled to add the additional month. B/GRAPH will automatically rescale both the horizontal and vertical axes any time that you make a change to the data that necessitates such rescaling. (You will be shown shortly how to manually rescale if you are not satisfied with the vertical scaling automatically selected by the program.)

ADDING A FACTOR

Imagine for a moment that the numbers on the graph represented the amount of money spent each month on your electrical bill. Now suppose that you want to also graph on the same chart, your expenditure for water and sewage. To do this we need to add a second factor.

Return to the Function Menu and then press Update. As before, the data entry screen will reappear. Note that at the top of the screen it says 'FACTOR 1'. The data on this screen is for FACTOR 1 (our Electric Bills) only. Without making any changes to the data on the screen, immediately press **ESC**. As before you will be asked if you want another factor. This time answer Yes.

In response to the answer Yes, you will be presented with a request to name the next factor and following that a data entry screen that has listed down the side the names of the seven months for which there was data in Factor 1. (If you simply press **RETURN** *when asked to name* the factor, the words FACTOR 2 will be used by B/GRAPH.) The reason that there are no additional months listed is that the bottom scale would not make sense if two factors had different numbers of data points. There is not data listed beside the names of the months, since this is a new Factor. (There is though a simple method for displaying multiple factors with differing 'amounts' of data. This is discussed under the heading "Missing Data".) The words 'Factor 2' is also displayed at the top of the screen.

The 'Cursor' is opposite MAR. Type in the following numbers at this time.

MAR	23
APR	29
MAY	35
JUN	27
JUL	20
AUG	31
SEP	25

Please type in the numbers exactly as shown here, since some of the work that we will be

doing in a little while requires the data to 'look' a certain way. There will be a lot of opportunity for you to make your own changes once you've mastered the fundamentals of B/GRAPH.

If you hit **RETURN** after typing in each number, the cursor will jump down a line to the correct position for the next number. You may use the cursor control keys to make any corrections. Remember, the columns of numbers do not need to line up.

Once you've finished, press **ESC**. Once again you will be asked if you are sure. Answer **Yes**. You will then be asked if you want another Factor. Remember, up to three factors are permitted. For now, answer **No**, and at the Graph Selection Menu select **Point** for point (scatter) graph.

You will now see a two factor graph displayed, using "+" for Factor 1 and 'o' for Factor 2. If you now type Attach you will see that a solid line is used to attach Factor 1 and a dotted line for Factor 2.

Type **Switch** and try a Line graph. Then Switch back again and try both the Bar and Segmented Bar charts. The Bar Charts will show factors side by side now and the Segmented Bars will have factors stacked one on top of the other. Note that Factor 2 bars are in a second color. (On a video monitor and on a printout they will appear striped. Please read the Appendix on Artifacting for more information.)

OPTION-ESC

Occasionally you may find that you don't wish to complete entering data for a second or third Factor. If you wish to abandon entering data simply press **OPTION-ESC** while in the data entry screen and that factor will no longer exist.

You may at this time experiment with all of the features that we have covered up until now including color changes, grids, printing and displaying the second screen. If you have not already done so, we urge you to read now the Foreword by Dr. Kogitz on the philosophy of graphs. This will assist you on choosing the type of graph most appropriate for a given application and data set. Although there are no hard and fast rules, certain types of graphs lend themselves best to certain types of presentations.

SELECT-ESC

If you are updating a multi page or multi factor graph, you may, when finished updating, press **SELECT-ESC**. This will terminate date entry while retaining the old values for all succeeding points.

A NOTE ON BARGRAPHS AND SEGMENTED BARS

Because of screen resolution limitations on the Atari, there are certain constraints within B/GRAPH on the number of factors and data points that can be displayed on each type of graph. Bar Graphs will be displayed three dimensionally until there is a total of more than 21 bars. This can be made up of any combination of data points or factors. In other words; two factors times 10 data points per factor, three factors each with seven data points, or even one factor with 21 data points.

Beyond 21 bars, there isn't room for the 3D type display without serious crowding, so Bar Graphs then automatically become two dimensional. Unfortunately there is also another limitation here: it is impossible to display more than 48 two dimensional bars and if Bar is selected and the total of the number of factors multiplied by the number of data points exceeds 48 then nothing will happen and you will have to select another type of graph display.

Segmented Bar charts also have limitations. Because the bars for each of the three factors are stacked vertically, one on top of the other, up to 21 side by side 3D bars may be displayed. Once B/GRAPH has automatically switched to two dimensional stacked bar charts the limit is 48. For all other types of graphs (excepting Pie Charts) you are allowed up to 100 Data Points for each of the three factors.

One more restriction on Segmented bars should be noted: although you haven't encountered them yet, B/GRAPH is quite happy to accept and to graph data containing negative numbers. By definition, Segmented Bar Charts are designed to illustrate how several parts combine into a whole, but if one of the parts contains numbers less than zero, a segmented graph would be meaningless. This type of logical error is trapped by the program once the inappropriate data is encountered and you will be immediately returned to the Graph Selection Menu so that another graph type may be chosen.

TUTORIAL SUGGESTION

Before proceeding, we would like you to e the new graph that we created (by adding a second factor to DEMO1.DAT). You should still have your own disk in the drive, used previously to save FILE.1. Make whatever color alterations that you wish and change the graph to a Bar Graph. Save this two factor graph as FILE.2.

IMAGING A GRAPH

If you refer back to FIG 1, you will see that there is a file on the Program Selection menu called 'Graph Labeling/Imaging'. This file will allow you to create Graph Image Shows; what some might call 'Slide Shows'. We use the term Image since what is displayed is not a data file as we have been working with up until now, but an Image or copy of the high resolution screen information.

There are several advantages to be derived from this approach, among them speed of redisplay and that Images can be placed into automated sequences much as you would show with a slide projector. You can also use this program module to Custom Label a graph with different colored and sized text. You will also be able to place text on graph Images in a number of different foreign language character sets.

All of this, and the fact that we have made the Imaging program module transportable, is possible because the graphs displayed do not require a 'GRAPHING' program module to recreate them. This tutorial will shortly cover in some detail how to use both the Labeling and Image Show features, but first we must see how to save a graph Image, that will be later used by the Imaging module.

Go to the Function Menu and note the command. . .

Image current graph to disk.

This is a command that is used while the Function Menu is displayed, just as with the Save command. Do not confuse it with the I that changes screen Intensity while a graph is displayed.

With your own disk in place, (it should have at least 66 free sectors available), press I. After giving a proper filename for the picture, the graph will be redisplayed and the drive will start up. You will notice a short white line move across and down the screen. This is the normal indication that the graph's Image, or picture, is being saved. Once the process is over, you are able to continue with all other B/GRAPH functions. The graph will have been saved to disk as a high resolution screen.

HAPPY MODIFICATION

It has come to our attention that our high speed method of saving Images (called Burst IO) does not work consistantly with Atari 810 disk drives altered with the Happy Computing modification. It appears that the track buffering in the Happy is unable to keep up with the flow of data when an Image function is performed. Our program IS compatible with ALL commercial single density disk drives with which we are familiar. Older Ataris with the 'A' ROMS in the operating system have similar problems. The only solution in this case is an upgrade to 'B' ROMS by an Atari service centre.

It should be stressed that, when a graph is Saved to disk as a data file, it is always available to be recalled with the 'GRAPHING' program module, to be Updated or otherwise altered. A graph Image can NOT be recalled with the 'GRAPHING' module. Its purpose is for use in Custom Labeling, Graph Image Shows and for saving Overlays only. For this reason, be sure that you also Save a copy of any new graph that you Create. You can always Image a graph that has been previously Saved, but you can't Display a graph Image from within the GRAPHING program module, Update it or use it in any of the Statistical Analysis Modules. Think of a graph Image as a disk version of a printer dump.

Imaged graphs may alternatively be called up by your own programs or by some commercially available programs. Due to differences in saving graphic screens, not all such programs will be able to load and display our Images. Our BASIC utility program on Disk #2, PICLOAD.BAS, allows for conversion between our standard and others.

RESCALING A GRAPH

With the Function Menu on the screen, note the Rescale command on the lower half of the screen. This is one of the group of commands that is performed WHILE a graph is displayed. It is also one of the most powerful commands available in B/GRAPH.

Display (load) the first file you Saved (FILE.1). You may have noticed that the vertical scale is numbered from 80 down to 40. SELECT the Second Data Screen and note that the data ranges from a high of 78 to a low of 50. Now Display (load) the second graph you saved, named FILE.2.

Note that the vertical scale now ranges from a high of 80 down to zero. Displaying the Second Data Screen shows that the lowest number is now 20. It was the lowering of the lowest data values that caused the automatic rescaling.

B/GRAPH contains a complex algorithm that, every time you enter data, examines that data and makes decisions on how best to scale the graph. The factors considered include both the absolute values and relative range of the numbers. The actual numbers used also take into consideration the 'clarity' of the numbers to be used as scale values.

For example, if you were to Create a graph to display the Dow Jones Average over the past three years, your numbers might range between 850 and 1300. If the program always made the base value zero, a great deal of the space on the screen would be wasted, and the line graphed would probably look quite flat.

Our development process has shown that the automatic scaling process produces the most appropriate vertical scaling almost all of the time, thus simplifying your job. A primary consideration in developing this algorithm was to maximize screen utilization. Thus for some applications, the scaling produced by B/GRAPH may not be exactly what you want. The Rescale command solves this problem and does even more.

With the data file FILE.2 displayed, press **R**. The rescaling selection screen asks for both a new HIGH and a new LOW value for the vertical (Y) scale. You may press **RETURN** to abort this function either at the first or second input request, and the current display will be redrawn unchanged. To see how this function works enter the values **70** and **20** for **HIGH** and **LOW** respectively.

RESCALING LIMITATIONS

The graph will now be redrawn, and the scale will now have the new HIGH and LOW values that you entered. There are several things to note about this process. If you are displaying a Point graph, only those points that appear within the range specified will be displayed. If you have an Attach on such a graph, only lines connecting points that fall within the displayed range will be

displayed. If nothing appears on the screen, then all of your data points lie outside the specified range.

The same thing applies to line graphs. Lines will be displayed only if the values for the imaginary points that they connect are within the graph's new display range. Bar graphs on the other hand WILL be drawn through a Rescaled range even if the bottom or top value does NOT lie within that range. This can lead to confusion as to where the actual minimum and maximum points are but, we feel this is preferable to showing no bars at all.

Experiment with entering a variety of different high and low values. You will find later, that particularly on graphs with a large number of data points, you will be able to create almost a 'ZOOM' effect; Zooming in on a narrow range of values and accentuating the scale for clarity.

If you forget what the original scale was, or simply wish to return the B/GRAPH's automatically determined scale, simply type the word "**AUTO**" at either the prompt for the HIGH or LOW scale values. The rescale function in our REGRESSION program allows even more flexibility, but we'll leave that discussion for later.

SMALL NUMBERS

One additional feature of Rescaling is the ability that it gives to B/GRAPH to handle very small numbers. We will discuss B/GRAPH's general range limitations in a future chapter, but with Rescaling it is possible to handle extremely small numbers outside of the normal range, including negative numbers. Overlays, the ability to superimpose one graph upon another also make good use of Rescaling, and we will examine that feature shortly as well.

A RECAP AND SOME TRICKS

We've covered a lot of ground by now and probably not all at one sitting. To consolidate what you have learned so far and practise your new skills, we will recap some commands and in doing so both learn a few tricks, as well as create another graph.

We will not tell you 'how' to do the things that you have already learned, but will simply use the command name. Display the graph FILE.2 and go to the Update screen. We will be adding a third Factor this time, but lets take a moment to examine one more function of the Entry Screen.

THE $ COMMAND

With the cursor at any position on the screen, press the **'$'** dollar symbol. This will display an inverse dollar sign in the lower right hand corner of the screen as a reminder that this function has been implemented. More importantly, when your graph is displayed, the numbers on the left hand vertical scale will be displayed with a dollar sign. You will note that pressing **'$'** also returns the cursor to the first data point at the top of the screen. Pressing **'$'** again toggles the dollar sign function.

What we want to do now is add data for a third factor. To quickly get to the screen for Factor 3, press **ESC**, answer **Yes**, press **ESC** and answer **Yes** again. This has moved you through the first two Factors. Note by the way, (we'll practice this later), that if you had answered No after the first question about wanting another Factor, you would have displayed a graph with only the first Factor, even if there was two or even three Factors worth of data in memory.

When asked for the second time if you want another Factor, answer Yes. When asked for a Name for Factor 3, simply hit RETURN for now. You will once again see a blank data entry screen-just as you did when you added Factor 2. Enter the following numbers.

MAR	40
APR	45
MAY	36
JUN	39
JUL	48
AUG	42
SEP	41

Press **ESC** and at the next menu select a Line graph. This will show you each of three line types (solid-dotted-dashed) available. Now Switch to a Point graph and then Bar and finally Segmented Bars. These are all of the graph types that we have seen thus far, but now with three factors visible for the first time.

MARKET GRAPHS

The one graph type that we haven't been able to display up until now, is Market graphs. There are two alternatives; Tic and Connected. Type **T** on the Graph Selection menu and a Market graph will be displayed. This is the type of graph that is traditionally used to display Stock Market information, in the form High-Low-Close for share prices. When entering data destined to be a Market Graph, it is a good idea to enter it in the appropriate order;

Factor 1 —High
Factor 2 — Low
Factor 3 — Close

If you do not, you always be able to change the order of the Factors using the program module called FILE MANIPULATION, described later. Note that you may do a market graph with only two factors, HIGH and LOW, in which case pressing either **T** or **C** will give you a 'Floating Bar' type graph.

Switch now to a Connected Market Graph. There is no difference between the two types other than the tick mark being replaced with a line connecting the 'close' data. This appears to be a matter of personal preference, so we have included both types in B/GRAPH.

If you're not comfortable with what you've learned so far, take a few minutes now to experiment and refamiliarize yourself with functions such as Color, Hue, Grid and Rescale. Save this new graph in a Market Graph form, but with any other combination of features that you fancy as FILE.3. We will use this file again in the following sections.

FILLING — AN INTRODUCTION

You will have noticed by now the inclusion of a Fill command on the Function menu. We have delayed its introduction until now since we needed a three function graph to be able to fully demonstrate Fill's powerful commands and full capabilities. These include vertical attachment of Point graphs and multicolored Area Filling of Line graphs.

Being able to do an area fill is valuable since that type of graph conveys a sense of 'volume'

better than a plain Line graph in many circumstances. Dr. Kogitz's preface on graphing describes this in detail.

FILLING A LINE GRAPH

With FILE.3 on the screen as a Line graph, press **F**. You will see the area beneath each factor sequentially filled in with a different pattern and color. If you now press **F** again, the filled areas will be erased. It is important to remember that any Fill command is an on-off switch like Attach, Vertical grid or Grid; press it once and it will Fill, press it again and it will erase. Please remember as well that 'area fills' only work on Line graphs. The area Fill command automatically determines the number of Factors used for that particular graph and sets the colors and patterns to be used in each for maximum differentiation both on screen and on paper.

We will shortly see how to manually Fill a Line graph so that you have complete control over each of the parameters. The algorithm used for the automatic Fill routine provides a quite successful Fill in most instances though. You will find later on and in your own work with B/GRAPH, that if you have produced a graph where the lines connecting the imaginary data points cross over each other in certain ways, you might be able to do a better job of doing an area fill manually yourself. Although more complicated than simply pressing F, you will see that you are able create area Fills that are much more sophisticated than those of which the automatic routine is capable.

FILLING MULTIPLE FACTORS

While not noted on the Function menu, Filling has three sets of additional commands. These are the numbers **1**, **2**, **3** and **SHIFT + 1**, **SHIFT + 2** and **SHIFT + 3**. Follow along and perform each step and this should all make sense in the end.

If you have not already done so, erase the Fill that you have just done, by pressing **F**. Remember that pressing F will toggle a Fill on and off. (Under certain circumstances, multifactor graphs where the lines cross each other may not be 'unfilled' completely, but you can do so manually, as will be seen.)

Now press **3**. You will see that pressing the number 3 will fill the graph UP TO the THIRD

factor. Here is an iimportant point! *WHEN AREA FILLING GRAPHS, THE NUMBER OF THE FACTOR ISN'T IMPORTANT, WHICH ONE IS HIGHEST ON SCREEN IS.* In other words, factor 3 need not be the top or highest factor, in fact in a high-low-close type graph factor 2 will be the lowest.

For example, if you had pressed 1, it would have filled up to the FIRST factor line which has the highest values. Press 3 again now to erase it and then try 1.

To summarise, pressing 1, 2, or 3 while a line graph is displayed will fill UP TO that factor. Press the same number again will ERASE back to the BASE LINE. Pressing another factor number during the 'erase' part of the cycle will erase downwards FROM THAT NUMBER.

PARTIAL ERASURE

You are probably wondering what good is a fill that covers other factors. Not much actually, but there is a simple way to erase the fill for any factor that we wish. Remember that we said in the previous paragraph that pressing the same number again will ERASE from that factors line back down to the BASE LINE? Now let's see what happens if you press another number.

Return to the function menu by pressing **OPTION** and **Display (load) FILE.3** again for a fresh start. Switch to a line graph and then press **3**. You will see that everything UP TO the THIRD factor is filled, covering factor two, the lowest one. Now press **2** and everything below factor two will be erased leaving just the area between factors two and three filled. Why? Because, if you recall, when using the numbers 1, 2, or 3 as fill commands, they act as toggle switches. press a fill number once, and it does a fill, press once again and the fill is undone or erased.

All we have done is filled to 3 and then erased to 2 leaving the area between three and two filled. The most important things to remember are that a numeric fill command alternately fills and then erases and that you should START FROM THE TOP.

USING ARTIFACTED COLOR IN FILLS

You may have already read APPENDIX B on color artifacting. Although you needn't understand it fully, it will help explain why some of these techniques work and possibly make their use a bit easier to comprehend.

Do the following: clear your graph of any fill. You can do this by doing a **1** and then a **1** graph, or just **reDisplay FILE.3**. Make sure it is in Line graph form again. Now press **SHIFT + 1**; that's pressing the SHIFT key and the number one down at the same time.

You will see that the area under factor one is now filled with an artifacted color. On a monochrome monitor it would appear as vertically striped lines. Press **SHIFT + 1** again and it will be erased. You can now do area fills in two colors; the solid color obtained by pressing an 'unshifted' number and the artifacted color produced by pressing SHIFT and a number. To get the third color do the following: Starting with an unfilled graph, press **1**. This will fill up to factor one with the first color. Now press **SHIFT + 1**. This ERASES, but only the lines of the first artifacted color, thus leaving behind the second artifacted color. Since the solid color, is made up of the two artifacted colors, removing one of them leaves the other.

To summarise then: To get the first (solid in monochrome) color in an area, press 1. To get the first artifact color, press SHIFT + 1. To get the second artifact color, press 1 and then erase with SHIFT + 1. Of course you would use 2 or 3 as well depending on which factor you wanted to fill. Do it a few times till you are comfortable. It actually works, and makes sense after a while, although at first it seems complicated.

FILLING THREE FACTORS WITH COLOR

Let's now see how to fill FILE.3 with three different colors. This, by the way, is an example of the most efficient way of filling a three factor graph if for some reason you find the automatic F function inappropriate. Starting with an unfilled graph, press **SHIFT + 1**. This will fill everything to the top of the highest factor (in this case factor #1), with the first artifact color. Now press **3**. This will erase everything except the fill between the first and third. Remember, the fill or erase will be done UP TO that number.

Now press **3**. This will do a fill up to factor three. Next press **SHIFT + 2** and everything up to factor two will artifact erased leaving the third color. You should now have a three factor graph filled with three separate colors. Users with monochrome monitors will of course not see the colors. For colors two and three you will simply see vertical lines. For graphs that are intended for

monochrome display, or printout in black and white, you needn't bother with color 3. The effect of color two and three is identical except when viewed on a color TV.

For the best effect and to make colors distinguishable when printing, make sure you don't have two artifacted colors sharing the same border. Use artifact-color-artifact or color-artifact-color schemes for best results. Your printer will print both artifacted colors in the same grey shade.

Clearly, this manual filling area process is not easy to explain. The best approach is just to experiment for a few minutes, and then reread the above section. A few steps are needed to accomplish what you want, but we feel that the flexibility that B/GRAPH's fill routine offers offsets its slight complexity.

A final note on filled area graphs. If factors cross each other, the results can appear confusing. B/GRAPH will only FILL an area that lies ABOVE another factor. Any area that falls below will remain unfilled. That is why the automatic single key F command is not always useable. This offers many opportunities to produce very confusing graphs. Only you can judge if your data can be meaningfully displayed in the 'area fill' mode.

FILLING A POINT GRAPH

The Fill routine produces solid fills when a graph is displayed in the Line mode. If you Switch to the Point mode, you will see that it can also be used for different purposes in that display mode.

With FILE.3 loaded, display a Point graph. Just as in the Line form you can now press F or 1, 2 or 3. The SHIFT option does not exist in this function. Just as in the Line mode, pressing a number will FILL to that number, and pressing the same or another number, will ERASE from there down to the base line. The FILL that is created here though, is a line connecting the Points that lie over each other for a given time period.

This means that you can connect any combination of two or three points. You can thus show with greater clarity the relationship between data points in the same time series. If you have a two factor graph, you can simulate a FLOATING BAR GRAPH with this technique. We leave it to you to experiment with this command since the underlying concept is the same as that for Line fills.

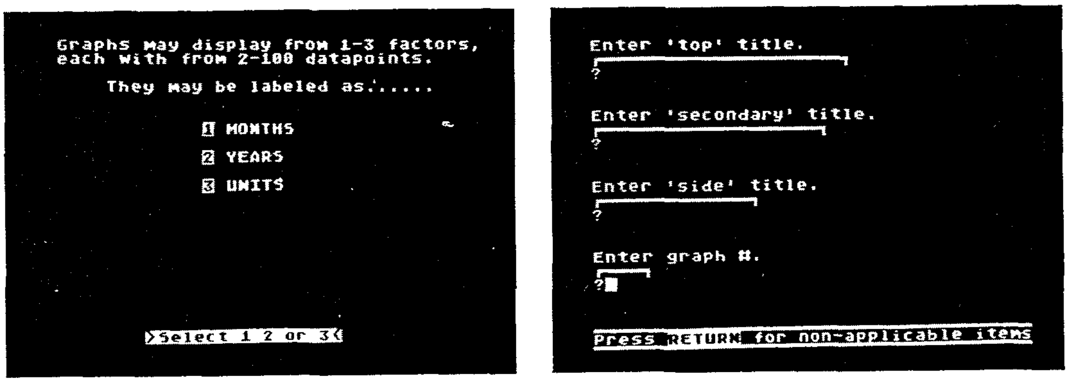
CREATING A NEW GRAPH

Although it may seem that we've approached this program through the back door, we will now examine the first and primary function of the Graphing module of B/GRAPH: Creating a graph.

The reason for the delay has been to instruct you in all of the functions necessary to Create a new graph through learning them slowly as separate support functions for other activities.

With the Function menu displayed, proceed now by pressing **C**. Be aware that by pressing **C**, you erase any other graph data which may be in memory at the time. For this reason always Save the graph you are working on before Creating a new one.

FIGURE 7A



The next screen displayed will be as illustrated in FIG 7A. You will be asked whether you wish to label the horizontal axis as MONTHS, YEARS or UNITS. This is not an irrevocable decision; almost no decisions in B/GRAPH are.

Here is what the three choices offer: if you choose 1 for MONTHS, you will first be asked for the Period. A RETURN will default to one month at a time, while any other number will cause the months to skip by that number. Next, you will be asked for the name of the starting month. This

must be a standard three letter abbreviation such as JAN, FEB, MAR, etc. If you do not enter an appropriate month name, you will not be able to proceed. If you simply press RETURN without entering anything, the default of JAN will be entered for you automatically. You may though choose to start on any month. If you recall, DEMO1.DAT started with MARch.

If you choose 2 for YEARS, you would then be asked for the starting year. This can be any two digit number such as 83. The word "YEAR" will be automatically displayed on the graph to help avoid confusion with the next label type, which is "UNITS". You must enter a two digit number to proceed.

If you select 3 for UNITS you will then be asked to name the units, to a maximum of eight characters. This can be anything you choose, such as WEEKS, DAYS, CENTURY or any other time division that might be appropriate for your data. Units may also be items such as SALESMEN, PLANETS, VEHICLES or the like. The default here if you simply press RETURN is the word 'Period'. You will be asked for both the starting period and interval, just as with the 'years' selection. The default starting period and interval if you simply press RETURN to either question is 1. You may select 0 as a starting period. This may be useful if you wish to treat the base, or X axis as other than a time series.

For each type of horizontal scaling and labeling, B/GRAPH is capable of displaying 20 individual month names, years or numbers. Since B/GRAPH is able to accept input for up to 100 data points (in each of three factors), if there are more than 20 items, subdivisions are used on the horizontal scale to indicate each item, but they are not labeled. This is simply a limit imposed by the resolution capabilities of the Atari.

INTERVALS

Depending on which scale value you have chosen, at around this point you will have been asked to 'Input Interval'. As mentioned previously you may simply press RETURN for an interval of one, or select any number that you wish. The interval chosen will then determine the amount by which *the major horizontal base divisions are skipped. For example if you chose three (enter 3) for an*

Interval and a starting month of MAY, the graph would be labeled MAY-AUG-NOV-FEB etc. YEARS, if incremented by six starting with 1950, would be 50-56-62-68 etc., and similarly for UNITS. This can be particularly handy if you are graphing selected rather than sequential time periods.

FACTOR LABELING

For the sake of this example, answer 1 at this time to choose MONTHS. When asked for the name of the starting month, use **MAR**, but first try typing some nonsense letters. You will see that only a valid month name consisting of the first three letters of each month will be accepted. If you choose UNITS, you would have to provide a name of up to eight characters long. The default label given by B/GRAPH is "Period".

You will then be asked to name FACTOR 1. If you recall, DEMO1.DAT had as it's label the word FACTOR 1. This is the default name if you decide NOT to name the label at this time. You accept the default by pressing RETURN. Similarly, when you are adding a second or third factor, either at the time of Creation or during an Update, you will be asked the same question for each. You may enter a name of up to eight characters long for a factor label or accept the default name "FACTOR" by simply typing RETURN. This decision can be changed at any time as well, so for now simply type RETURN.

ADDING TITLES TO THE GRAPH

There now will appear in sequence, four questions. These will be. . .

Enter 'top' title.

Enter 'secondary' title.

Enter 'side' title.

Enter graph #.

None of these questions have a default. If you do not want to place a text label on the graph in any of these positions, simply press **RETURN** and nothing will appear on the graph. You may of course type in anything that you wish in answer to the questions and you may also use lower case, numbers or inverse text.

The 'top' title will appear at the very top of the graph, with whatever text you enter up to 20 characters, centered over the graph. The 'secondary' title, up to 19 characters long, will appear just under it. The 'side' title, up to 13 characters, will appear vertically down the left side of the graph alongside the vertical scale, one letter under the other. The graph number is for your convenience in identifying graphs and will be displayed in the upper left hand corner. The # sign is displayed automatically alongside your input. The letters and/or numbers you enter for this item will be automatically displayed in inverse on the graph to highlite them.

Please note that each label has a maximum length as shown by the entry box on the screen over entry line. ONLY what will fit in the box will be displayed, though you are able to type beyond the end of the box. As with almost all other inputs in B/GRAPH, you are not making an irrevocable decision when you make one of these entries, so at this time type in anything that you wish. For example. . .

Sales Forecast

Orbital Velocities

$ BILLIONS

S45

You will next be presented with the by now familiar Input Screen. There are only a few new things to be learned at this time. If you recall typing the $ sign will place a dollar ($) sign in front of the vertical scale. Press $ now. Remember, if you decide at any point that you want to get rid of it, simply type $ again. It will no longer be displayed on the lower right hand portion of the screen once you type $ again.

DECIMALS AND NEGATIVES

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The world is not made solely of integers and positive numbers. B/GRAPH is capable of displaying decimal numbers as well as numbers less than zero. Try entering the following numbers.

MAR	124
APR	68.56
MAY	20
JUN	−35.7
JUL	−234
AUG	−45
SEP	29.89
OCT	88.01
NOV	183

You may type numbers with decimals and minus signs. On the second data screen though, only two decimal places will be displayed. All nine significant digits are used for calculations. The largest number which you can enter into B/GRAPH is 9,999,998. Any number over this will be interpreted as N/A (Not Available, or Not Applicable) and not displayed.

Using all cursor control keys, you may change anything on the input screen at any time. B/GRAPH does not read and examine the screen for your data until after you have pressed ESC and Yes and only then is the data 'input' for setting up your graph.

Do not select a second factor at the moment, but choose a Bar graph display. You will see that the zero base line now floats upwards, and both the positive and negative scales have been automatically scaled.

Spend a few minutes experimenting with all of the different graph types and other features including Grids, Rescaling and Color changes just to ensure that you are quite familiar with their functions once more. Review the previous chapters at this time if anything seems unclear. Do not remove the graph we have just created though, as we will be using it in the next section of the tutorial. To take a break now, simply Save this graph to disk.

OVERLAYS

When producing graphs, it is frequently desirable to superimpose different graphs on top of one another so that similar, or even possibly unrelated things can be displayed and/or compared on screen or on paper at the same time. B/GRAPH has such a feature and it is available as the Overlay function. This is addressed WHILE a graph is displayed by pressing O.

It can not be stressed too strongly that while it is possible to create extremely useful and attractive graphs with the Overlay function, it is also very easy to produce a total mess!!

To aid in Overlaying, B/GRAPH automatically rescales the incoming graph to the scale of the graph currently on the screen. If your first scale ranged between zero and 1000 and the second between three and seven, you will not get a meaningful overlay. It is up to you to make sure that your data and graphs share relevant information in order to use the Overlay function properly.

You should also note that B/GRAPH overlays the second title on top of the first. Titles of different sizes may leave characters on the screen that cause a jumble rather than a coherent title. To avoid this, use the Update feature described earlier to reduce or erase titles that might interfere with an overlay. Remember that overlays may be printed at any time by pressing START.

PRODUCING MEANINGFUL OVERLAYS

If your Overlay was a mess, there are ways to improve it. First, make sure that the horizontal scales are not different and share the same number of data points. FILE.2 has seven months of data, starting with MAR, while the FILE.3 has nine months worth of data. You will see how to correct this shortly.

Also, make sure that the vertical scales on the two graphs are roughly within the same range. If there are great differences between scales, you may not be able to produce a good overlay. If the differences are relatively small, try rescaling the screen graph to the data of the overlaying graph. Negative data in the overlaying graph will be lost if the screen graph has only positive values.

TRUNCATING DATA POINTS

Reducing the number of data points is easy. Simply use the SPACE BAR to erase the value for OCT. This not only removes that value but also terminates the graph at that point. In other words we could have had many more months worth of data on the screen, but by making a given month blank, we are indicating to B/GRAPH that data entry ends HERE. If we had multiple factors, each of those factors would now end at the same point as well! B/GRAPH will become upset though if you do this to the second or third factor. You cannot truncate a factor other than the first one.

In order to add data points, you can again use the Update feature and add alpha characters as "not applicable" data points. This is described in greater detail later.

Before leaving Overlays, there are a few points to remember. You may have as many Overlays as you wish superimposed one on top of the other. How this looks is simply a matter of how careful you are in organizing your data. You also can NOT Save an Overlay. As far as B/GRAPH is concerned, it can only contain one graph's worth of data at a time; the last one Created or Displayed, (Loaded). You CAN Image an overlayed graph, and with a little work these can be effective in presentations. Naturally you may also dump to a printer any graph or Overlay that is displayed.

ALTERING GRAPH LABELS

The last major GRAPHING function to be covered is Altering the graph label information. As we have stated earlier, you always have the option of changing virtually anything in B/GRAPH and Labels are no exception.

From the Function Menu, press Alter and you will be presented with the first of the alterations:

Enter 'top' title.

This is the same series of questions as the original labeling sequence and each subsequent question will be asked in turn, just as when you create a graph. If you simply press **RETURN**, whatever had been previously entered will remain unchanged. To type NEW information at any

question, just type in that new information. If you wish to erase, or blank out a text line for any label, just type a period ' . ' and then RETURN. It seems more logical to have had a command such as "Press space bar", rather than a ' . ' to delete a line, but the Atari's Operating System doesn't recognise blank spaces by themselves. Remember to stay within the length restrictions, signified by the open "box" on the screen. If you type beyond the markers, your text will appear truncated on the graph.

You will also have the option of changing the horizontal scale time series, in the event that you had originally made an error in selection or you have a change of mind. You will later have the opportunity of placing 'custom' labels anywhere on a graph, in four different sizes of text, differing colors and even in a multitude of type styles and foreign language alphabets. This will be performed with the Imaging/Labeling module and information on how this is performed is contained in the tutorial for that section.

HANDLING MORE THAN 20 DATA POINTS

We have mentioned that you are able to enter a total of 100 data points for each of the three factors. Since each Input Screen can contain up to 20 items, you are able to enter up to five screens worth of data.

You haven't encountered the subsequent data screens yet, since we have been dealing with less than 20 items in all of our examples thus far. You will be asked if you want to enter more data, only if you enter a full 20 data points on the first screen. To see this Create a new graph and enter a full 20 numbers. You will note that after the 20th item has been entered the cursor jumps back to the top of the screen.

When you are satisfied that the data for these 20 points is correct, press **ESC** and **Yes**. Unlike before, when we were dealing with less than 20 numbers, you are now asked if you want another Page or another Factor. If you were entering EXACTLY 20 items, then you could press **F** and either input the data for a second factor, or display the graph.

Press **P** and you will have another data entry screen presented. If you are working with

months, the sequence will continue and similarly if your horizontal scale had been selected as UNITS or YEARS, that numbering would be continued as well.

You can use ESC at any time to go to the next factor (including adding new factors to your graph data) or to display the graph. If you choose to enter a second or then a third factor, you MUST enter data for the same number of data points in each of the second and third factors as you had in the first one. If you do not have data for all points in each factor, there is a way of still displaying a meaningful graph, described below.

MISSING DATA

One function of B/GRAPH that isn't performed with a function key, or noted on a screen menu, is the handling of missing data. There may be instances where you have data for a time series, but are missing one or more data points. B/GRAPH is able to handle such occurrences quite simply. All that is required is to type **"NA"** (Not Available or Not Applicable) instead of a numeric value when entering data on the Input Screen.

Actually, you do not need to type NA; any Alphabetic character (letter) will accomplish the same thing. Regardless of what you actually type, NA will be inserted by B/GRAPH on the Second Screen display and on the Update screen the next time you return to it. Do NOT leave a blank space for missing data, as B/GRAPH will interpret this as the end of data, not as missing. You must type a letter or letters instead of numbers to signify unavailable data.

When the graph is displayed, B/GRAPH will simply skip over that position on the time series. For example, if you are doing a line graph, the line will stop at the last position for which there is data, and resume again as soon as the next position does contain data.

As mentioned earlier, you will sometimes find that you have the need to plot 2 or 3 factors on a single graph though the amount of data for each factor isn't equal. Simply type in an 'NA' for all data points that are not available for a given factor and B/GRAPH will be able to plot a graph even with unequal factor lengths.

Segmented Bar Charts present one last consideration. If there is missing data in ANY ONE of

the two or three data points of a given time series, then THAT time series will not be displayed. For example, suppose you have twelve months worth of data for three factors. If you are missing data for Factor #2, in June, NO stacked bar will be drawn for June, even though the data for Factor #1 and #3 are there.

BORDERING THE GRAPH

Although it is not noted on the Function Menu, there is one more minor function available called Border. At any time while a graph is displayed, you may press B and the left side and base line that define the edges of the graph will be completed on the top and right side to form a completed border around the graph. This is strictly a matter of taste; we feel that graphs with only a few data points look best without it. You may remove it by pressing B a second time. Border is not saved to a data file, but of course it may be part of an Imaged graph.

You may notice when Bordering a graph on which you have placed horizontal Grids, that the Border function causes an odd appearance at the top of the graph. This is particularly noticeable when a solid Grid has been layed down with the CTRL-G function. The solid line of the grid for the top scale number is too close to the top line created by the Border function.

We have therefore provided an additional function not noted on the menu screen. This is CTRL-B. When used instead of B it only draws the right hand side vertical Border and not the top line. Thus the top Grid line becomes by default the top Border of the graph as well, lending a much cleaner appearance. Once again, the choice of which combination of Grids and Borders is yours, and should be determined by what appeals to you.

EXITING TO THE PROGRAM MENU

Once you have finished with a module such as GRAPHING, you will need to return to the Main Program Menu to obtain access to any of the other Modules. The way to do this is by typing Exit from the main Function menu, not by hitting **BREAK** or **RESET**. If you have data in memory, you will be advised on the screen and given the opportunity of saving it to disk. Once you leave a module, any data in the computer's memory will be lost.

If you do not have data to Save, ensure that a B/GRAPH disk (Program Disk #1 or #2), is installed in drive #1 and press RETURN. Though each B/GRAPH disk contains different programs and files, both disks contain the Main Menu program and thus you can exit any program module with either disk in place. You will shortly see the program selection menu and should now proceed to load PIE CHARTS in preparation for the next tutorial.

GRAPHING CONCLUSION

This concludes the tutorial section on the GRAPHING module. In most of the other program modules such things as data Input Screens, printer dumps and returning to a Function Menu work in the same manner as you have learned them up until now. Any differences will be noted when encountered but for the sake of the tutorial we will assume that you have familiarized yourself with the preceeding lessons. Therefore before moving on to the PIE CHART tutorial, make certain that you are familiar with all of the concepts presented thus far, as we will be assuming this familiarity from now on. Consult the Reference Guide if you need a brief refresher on commands.

PIE CHARTS

This tutorial will discuss the B/GRAPH program module called PIE CHARTS. It is loaded by selecting #3 on the Program Selection Module. You must load PIE CHARTS, as well as each of the other B/GRAPH modules by booting disk #1, and selecting the one you wish from that menu, or by exiting from a program module and returning to the Main Menu.

This tutorial assumes that you are already familiar with all of the functions of the GRAPHING module. Functions that are identical between them will NOT be re-explained here, therefore if you have not read and practiced the GRAPHING tutorial yet, please do so now. If any function is unclear in PIE CHARTS, please refer back to the previous tutorial.

THE FUNCTION MENU

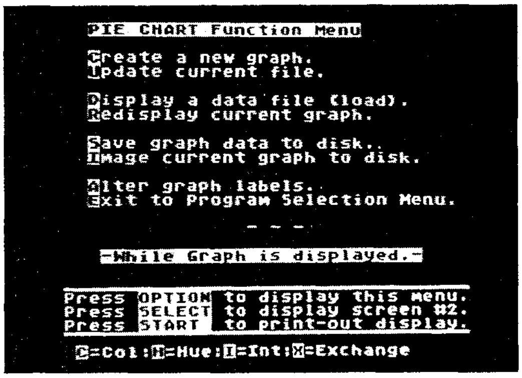
Once you have loaded PIE CHARTS, spend a moment examining the Function Menu. You will note that it is almost exactly the same as the menu in GRAPHING. All available functions work identically.

Although the top half of the menu is unchanged, several Functions are missing from the —WHILE GRAPH IS DISPLAYED— section of the menu screen. In fact everything EXCEPT the screen color controls is gone. Obviously Grids, Rescaling and Attaching, are not meaningful on PIE CHARTS. If you are unfamiliar with the concept of Pie Charts and how they are used to present data, please take a moment to read Dr. Kogitz's essay at the front of this manual.

CREATING A GRAPH

Press **C** so that we can Create a sample pie chart. You will first note that a series of questions regarding screen titles are asked. Pie Charts are labeled similarly to the other types of graphs previously discussed, except that there is no 'SIDE' title, and the 'BASE' title will be in double sized text at the bottom of the screen.

FIGURE 9



Type in whatever you please for the titles at this time, and when finished, you will next encounter the Data Input Screen. Although it superficially resembles the Input Screen on GRAPHING, it is different in many ways, which you will see when we start entering data.

Down the left hand side of the screen are numbers from one to 16. The purpose of a PIE CHART is to represent data as parts or percentages of a whole. B/GRAPH can handle up to 16 'slices' in a pie, and you have to enter both the LABEL for the slice and the data. This is done on the same line of the input screen, opposite each of the numbers from one to 16.

For example, lets say that we wish to enter the number of Girl Scout Cookies that a group of girls have each sold. We would do the following: Type SUSAN, now press RETURN. The cursor will skip across the screen to the left hand side. Now type 11 and press RETURN.

You will have entered two 'FIELDS' worth of information; a LABEL and DATA. Each related set is typed on a line one after the other. Pressing RETURN moves you from one FIELD to the other. You may now type in another name since after typing '11' and RETURN the cursor jumped back to the LABEL FIELD for the next item.

Type in the following. . .

JANE	9
BETTY	15
NANCY	18
SALLY	14
GRACE	3

You can use the cursor control keys to move back to any LABEL from a data point and make any changes that you wish. You can not use the cursor keys though to move across the screen completely to the DATA field. You must press RETURN to move across to the right hand entry field.

The LABEL you type can only be eight characters long. If you attempt to type more than this the cursor will not move beyond that point. You may type numbers in a label field, for example 'R2D2', but you can NOT type a letter (alphabet character) in the data field on the right hand side of the screen.

The use of the DELETE key is allowed as is SHIFT DELETE, but in case of the latter, if you start deleting (eating up) text, any numerical values in the Data field will be pulled across the screen and deleted as well. This 'feature' is in the nature of the Atari's operating system, but can easily be avoided if you watch the screen and input your data carefully.

MISSING DATA

If you recall, typing NA in the GRAPHING module was a signal to the program that there was missing data. Since by definition, a pie chart is to display the percentages each part is of a whole, there can be no missing data or NA entries.

Once you have entered the above data and experimented with using the RETURN key and the usual cursor controls to move between FIELDS on the screen and edit your data, press **ESC** and **Y**es to draw the graph.

THE PIE CHART

The Pie Chart will now be drawn. Centered around each 'slice' of the pie, just outside the circumference of the circle, is a letter of the alphabet starting with 'A' at '3 o'clock' and moving counterclockwise around the chart. To the right of the chart is an enclosed rectangle containing each letter that labels a slice of the pie; the LABEL that you typed in and the PERCENTAGE of the whole that each value that you entered represents, rather than their actual values. The rectangle is NOT of fixed size and will change to accommodate the number (between one and 16) of items that you have to enter. The diameter of the circle however, is fixed.

These percentages have been calculated to two decimal places for precision. If you press **SELECT** for the second screen, you will see the LABELS and values that you entered, plus a TOTAL of all of the data at the bottom of the screen.

Take a look at the pie itself; you will see that the first (A) slice is solid, the next (B) blank or background color, the next an artifacted color and the fourth striped. This sequence is repeated around the entire chart. If the last color would end up solid, it might look fine on the screen but poor when printed. What B/GRAPH does in that case is break the order and make the last color striped or the background color instead if appropriate.

PRINTING A PIE CHART

Pressing **START** will produce a printer dump if all of the usual set up procedures have been met (appropriate printer; interface on; printer set to On-Line). Of course the second (data) screen may also be printed by pressing START.

You may notice that the circle drawn on your TV or monitor is not quite perfect. It looks slightly flattened at the top and bottom. This is because in all graphics modes on the Atari computer (our graphs and charts use mode 8), the pixels (dots on the screen) are taller than they are wide. Although our circle is 130 pixels wide by 130 high, it appears slightly ovoid. The circle printed out on paper when you do a screen dump IS a perfect circle on many printers since they will print the same number of dots in either direction. This family includes the Epson FX series, Oki 92 and Centronics 739. Epson MX series, as well as Gemini and Seikoshia unfortunately do NOT print

the same number of dots vertically as horizontally and thus the pies will not appear circular.

We could have compensated for this discrepancy on the screen, but decided that circular print-outs were to be preferred. Most TVs are not aligned accurately enough for it to be bothersome in any event. For photographing the screen, or screen presentations where precision counts, you may be able to adjust the horizontal and vertical linearity of your TV or monitor. If such controls are not immediately accessible, please contact a competent technician for assistance. TV sets and monitors contain lethal voltages! Do not perform any adjustments not intended for consumer alignment.

EXCHANGING DATA WITH OTHER GRAPH FILES

It is possible for you to use this Pie Chart module to call up data files created with GRAPHING and create Pie Charts from those files. It does not matter if the files you are calling were saved as Bar Charts, Line Graphs, Scatter or Market Graphs. The sole limitation is that ONLY the first factor, Factor 1, will be used by Pie Chart, and the data must contain not more than 16 data points. None of the values may be negative, as well. If there are more than 16, the file load will abort and you will be returned to the FUNCTION MENU. The reason for this is that a pie chart is used to represent items as part of a whole. If there are parts missing the chart would then become meaningless. Similcrly, there can be no negative or NA values in the data loaded into a pie chart. Remember too that there is no side title on a pie chart and that the second title will appear below the chart, not above.

If the data that you wish to turn into a pie chart is in a factor other than Factor 1, you can use the program module called FILE MANIPULATION to switch their order. This tutorial is found further on in this manual.

When loading a non-Pie Chart File, rather than immediately drawing a graph, you will find yourself presented with an Update screen. This is to allow you to type in label names, since obviously there were not created in the GRAPHING program. If you just want to look at the graph, simply type **ESC**, since LABELS are not mandatory.

Similarly, you may also load a Pie Chart data file into GRAPHING with the Display command and use it to produce any of the available graph types. It will be in the form of a single factor graph with UNITS as the horizontal axis. The LABELS will not be displayed or retained if the file is reSaved.

PIE CHART CONCLUSION

You should spend some time practicing the creation of a number of different Pie Charts and also the various functions on the Function Menu such as Altering label information, Color, Hue, Imaging and of course Saving a data file. You will find that now that you are familiar with the basic functions of B/GRAPH, learning this and the other program modules will go quite quickly.

To go to the next program module, return to the Main Menu by pressing **E** and choose the IMAGING AND LABELING program module.

IMAGING AND LABELING

This Program Module allows you to perform four different tasks, each using the Images created with GRAPHING, PIE CHARTS, or REGRESSION. Each of those modules allows you to create a graph and then Image it to a disk as a high resolution picture file rather than a data file. It is Image files that this module utilizes.

This program is different from the other main program modules in B/GRAPH. It can be copied to any other disk. It can also be used with a DOS other than DOS II. This is allowed since it contains a section that allows for the display of Graph Image Sequences, or Slide Shows. This means that you do not need to take your valuable B/GRAPH Master Disks with you if you wish to present a slide sequence away from your usual location. (The printer dump routines will NOT work under these circumstances though.)

Please be advised though, that these files are Copyright, and may not be resold, copied, or otherwise distributed. They are for the sole use of the Registered Owner of this copy of B/GRAPH. Please respect our efforts in creating this program and honor our copyright.

The files that need to be copied are:

SHOW
DUMPER
TXTLONG

Use your regular DOS to copy these files to any other disk (refer to your DOS manual for information). All three files MUST be resident on the same disk for the program to work and you invoke the program by typing. . .

RUN"D:SHOW"

As just mentioned, this module is concerned with graphs that have been stored on disk in Image form from other programs such as GRAPHING. If you ever have difficulty identifying B/GRAPH Image Files, remember that they occupy exactly 66 disk sectors; a directory scan will help locate them. Data Files on the other hand only occupy between two and about eight sectors on a single density disk.

Two major functions available in this module allow the Custom Labeling of graphs and the creation and retrieval of Image shows, otherwise known as 'Slide Shows'. You may have noticed that although both the GRAPHING and PIE CHART programs allow the creation of Images, neither permit their re-display.

REVIEWING IMAGES ON DISK

From the Program Selection Menu, choose GRAPH LABELING/IMAGING and shortly you will be presented with the B/GRAPH IMAGE FUNCTION MENU as illustrated in FIG. 10 below. The First selection is Display Images on disk. Select **D** now and at the next prompt insert B/GRAPH Disk #2 and read the directory. You will note a file named DEMO5.PIC.

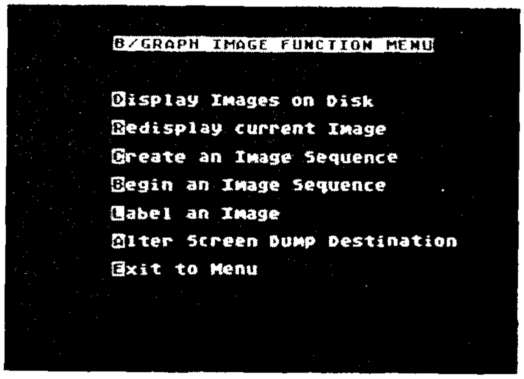


FIGURE 10

This is a graph Image, and as previously mentioned, can be differentiated by the fact that it is 66 disk sectors long. Type in the file name and you will see the file displayed. Be aware that you can not make any data alterations to this file. We are not using the data that created the graph, we are only displaying its Image or picture.

We are getting ahead of ourselves by mentioning it here, but there is a shortcut from this section to the Custom Labeling section of this module. If you press **SELECT + START** at the same time 'while' an Image is being displayed that has been called with the Display function, you will be asked for an output file name and then moved to the Labeling function directly.

What is happening here may not be clear yet but once you understand the functioning of this module, reread this section and its purpose will be clarified. What we have provided is a method whereby instead of having to return to the Function Menu, select Labeling and then call up the same graph again, you can move directly from Review to Label.

Do not do so at the present time, but simply remember that it is possible. As you become familiar with the operation of this program module, this convenience feature will become appreciated.

PRINTING AN IMAGE

At this point, pressing **START** will do a printer dump, to any B/GRAPH-supported graphics printer. You will probably want to wait to try this until after you have done some Custom Labeling, described below.

CUSTOM SCREEN PRINTING

Since this module of B/GRAPH can be RUN separately, if you have a special screen dump routine that you prefer to use with your printer, such as the APEX Screen Sump Utility with a Centronics 739, you can boot that routine and then simply RUN"D:SHOW". You may now execute your commercial dump routine normally. As mentioned previously, PICLOAD.BAS is the preferred method for custom printer dumps, as few such programs can co-exists with SHOW.

A simpler to use program is also included on B/GRAPH Disk #2. Its name is PICLOAD.BAS. It is a stand-alone, unlocked, unprotected, listable BASIC program whose sole purpose is to allow you to use a commercial screen print program for enlarged printouts of Imaged graphs. This program may be copied freely. You may thus give a copy of PICLOAD.BAS to a friend or associate, thus giving them the ability to display or custom print your Image files, which could be placed on the same disk.

DUMPING TO DISK

We have thus far learned how to save a data file to disk, dump a graph or chart to a printer and Image a graph to disk. B/GRAPH offers one additional alternative and that is a 'dump to disk'.

You will see on the main FUNCTION menu the command "Alter Screen Dump Destination". This allows you to alter the destination of a dump which is initiated by pressing START. The default, and all that is available in the other modules, is a 'printer' dump. Press A now and select **#2** to send the output of a 'dump' to the disk.

The next screen will look familiar; it simply requires that you now enter a file name to which the dump will go when **START** is next pressed. All of the usual rules for file names apply as well as the availability of a directory by simply pressing **RETURN**. After entering a file name you will be returned to the main FUNCTION menu, and may proceed to any other function. A 'dump' file incidentally takes something over 100 sectors, depending on the printer type for which you are set.

WHY DUMP TO DISK?

The ability to dump to disk will only be of use in specialised cases. Our intention is to make it possible to integrate a dumped graph into text created by a word processing program. Unfortunately, our research shows that most currently available word processors for the Atari are unable to pass the escape sequences imbedded in the file. One word processing program that *does* allow the loading of B/GRAPH printer dump file is PaperClip™ from Batteries Included.

If you have a PaperClip or other program that will pass ESCAPE sequences, then you should be able to append or call up one of these files to place a graph dump exactly where you want

it in your text. The beauty of this approach is that you no longer need a B/GRAPH program module to perform a printer dump. You can see how this works with a simple experiment.

Take a file that you have created with a 'disk dump', and then boot Atari DOS II, without BASIC. Using the Copy function do a copy from that file to your printer using the form. . . **FILE.EXT,P:**. A printout of the graph will now be 'copied' to your printer just as if it was being done from within B/GRAPH.

You may change back to a printer dump at any time by selecting **Alter** and **#1**. When you leave the IMAGING/LABELING module, the default of a printer dump will be reset in any event.

LABELING AN IMAGE

The purpose of this section of the program module, is to place text on the screen. While GRAPHING and PIE CHARTS allowed text labels to be placed on the screen and Altered, that text was restricted in size, and color and its positioning on the graph was determined by B/GRAPH. It is the purpose of this program to provide you with the utmost flexibility in placing a variety of text in different sizes, character sets and colors on any graph or chart, or to create text-only pages. These Images may then be printed out, to paper or disk, or reImaged to disk for later use or inclusion in a Slide Show.

After having loaded an Image with the Display command, return to the FUNCTION menu by pressing **OPTION**. (Just as in all B/GRAPH programs, you may Redisplay at any time from the Main Program Menu.) Now press **Label an Image**. For the moment, do not make any further selections while we discuss the options available.

The next screen presented (FIG 11), asks the size of type that you wish to place on the graph. You will shortly see how each of them look, and as noted at the bottom of the screen, you are able to return to this menu at any time by pressing **START + SELECT** simultaneously. This will allow you to alter your selection at any time.

FIGURE 11

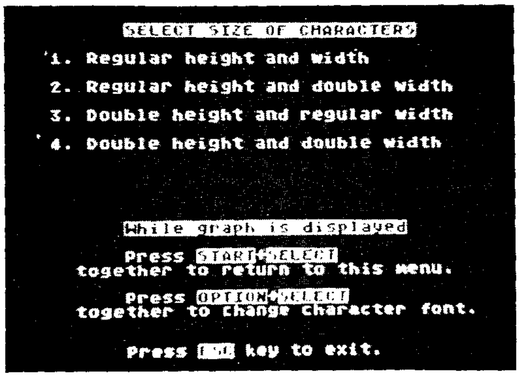
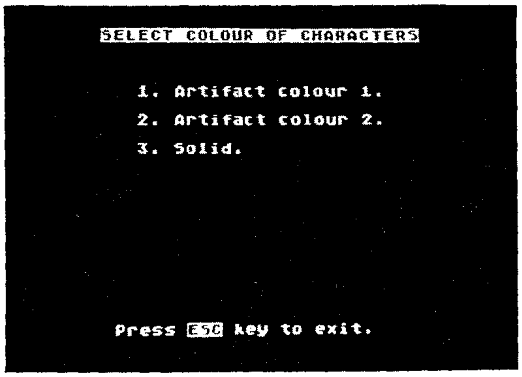


FIGURE 12



If you were to now select either #1 or #3, you would see the directory screen for calling up a graph Image for Labeling. We will cover this in a moment. If you select either #2 or #4, you will be offered a second menu screen (FIG 12) that requires you to choose either solid text, or one of two artifacted colors.

At this time, select #2 from the CHARACTER SIZE menu (regular height and double width) and then #1 from the CHARACTER COLOR menu (artifact color one). The usual directory menu is displayed next and you will once again be asked for a file name. Please recall the same file mentioned earlier, DEMO5.PIC. Unlike similar screens in GRAPHING and PIE CHARTS, you will also be asked for an Output File Name. This allows you to then press SELECT at any time to reImage, saving the current picture file to disk while it is displayed.

To avoid having to ask this question, then necessitating a redisplay, we ask it now. For safety's sake, do not give the SAVE name the same file name as the original. It is all too easy to mess up the screen while labeling and then overwrite your only existing copy of a picture file. If you are

confident with what you are doing, particularly if you have a back-up copy of your original file saved on another disk, you can simply press RETURN and B/GRAPH will set the 'SAVE file name' to be the same as the input name.

Once the Image has displayed, remove the B/GRAPH Disk #2, and install the working disk that you previously used to Save graph data. You may of course use any diskette that has at least a few hundred blank sectors. We will be saving several Images back to disk.

MOVING THE CURSOR

The first thing you'll notice in the Labeling mode is a large cursor in the middle of the screen. This cursor is what is technically called a 'Player' on Atari computers. It has the ability to move about the screen and pass above anything that lies beneath it without erasing or conflicting with it in any way. For more information on PM Graphics, see 'Mapping the Atari', published by *COMPUTE* Books.

Depending on the size of text that you choose, the cursor will be either a square or a rectangle the size of the text character that will be printed on the screen. It will as well be either a light or dark color depending on the Intensity of the background of your graph Image. If the graph has a dark background then the PM cursor will be light, and vice versa. You may find that the colored cursor may be hidden though, if the Image just loaded has a complimentary colored area right at the centre of the screen.

There are a number of ways to move the cursor. The first is through the use of the cursor control keys. Pressing CTRL and one of the ARROW KEYS will move the cursor in that direction. Practice moving the cursor about the screen. The speed of the cursor is a compromise based on accuracy of location vs convenience. There are ways of moving the cursor quickly across the screen, which we will learn shortly.

You will note that the keys 'auto-repeat'. That is, if you hold one of the arrow keys down for more than a second or so, the cursor will continue to move in that direction. You may also stop holding the CTRL key once the cursor is underway.

USING THE JOYSTICK

If you have a joystick, plug it into connector 0 (the leftmost port on the 400/800, front port on the 1200XL, 600XL and 800XL). You will find that by moving the stick in each of the four cardinal directions, you will move the cursor. The choice of keyboard or joystick is yours.

PRINTING TEXT TO THE SCREEN

You may have noticed that pressing any of the other keys does nothing. Move the cursor to a clear portion of the screen in the upper left hand corner. Now press either ESC or the red button on the joystick. The border of the screen will illuminate when you do this. This is your indication that you are in text entry mode.

While in this mode, anything that you type will display on the screen. Try it now. All of the control characters, inverse and lower case as well are available. You can even place arrows on the screen by typing CTRL and one of the cursor keys. In this mode, the cursor controls DO NOT move the cursor. They print their ASCII character representation.

We suggest that if you have your Atari manual handy, you look at the table that shows the graphics characters and CONTROL character representations. You can place ANY Atari character on the screen.

To regain control of the cursor, all you need do is press **ESC** again. The bright screen border will disappear and both joystick and keyboard cursor control are returned. Note that pressing the joystick button does NOT return control. It will only 'activate' text entry mode, not turn it off. This is because you will be typing and thus able to press ESC from the keyboard directly.

QUICK CURSOR CONTROLS

Practice moving the cursor around the screen and entering text. You may have discovered that there are a few key commands in the text entry mode that actually perform functions rather than print a character. These are **DELETE**, **SHIFT-INSERT**, **CTRL-INSERT** and **CTRL-DELETE**. Here's what they each do. If you press **DELETE** the cursor will jump back a character space. It does not erase what was underneath, but you now can type over an error.

It can also be used to move rapidly across the screen. To do so simply press **ESC** to go into text entry mode and then use the **DELETE** key to skip across the screen from right to left. To move rapidly from left to right, you can press **SHIFT + INSERT** simultaneously. Just remember to keep your eye on the screen border color to remember in which mode you are.

Similarly, **CTRL-INSERT** will move the cursor downwards one character position and **CTRL-DELETE** will move the cursor upwards. These four keystroke combinations allow rapid cursor motion anywhere on the screen while labeling.

CHANGING TEXT SIZE AND COLOR

You may recall that the CHARACTER SIZE selection menu had a reminder that pressing **SELECT + START** at the same time, would return to that menu. Do so now, but be sure that you are careful to press them simultaneously otherwise if you press **START** accidently and your printer is on, you will do a screen dump, and if you press **SELECT** the current screen will be Imaged to disk.

IMPORTANT NOTE
You will be unable to leave the labeling screen to either reselect new text size and color, or to return to the FUNCTION menu by pressing *OPTION* while you are in labeling mode. In other words, you must use *ESC* to turn off the screen border before either of these options can be activated.

Once back at the SIZE menu, choose another size, say #4, and then on the color menu, select color #2. After you have experimented for a while, you will note that the characters are printed exactly in the lower left hand corner of the cursor area. You can place a letter quite precisely with a little practice.

Practice labeling the graph. You can use the SPACE BAR as a convenient device to erase text that was placed in error, but of course it will erase as well any portion of the original graph that underlay the text. The ability of the SPACE BAR to erase the screen material should not be underestimated. It will allow you to create some quite unique graphs and label options if you take the time to experiment with it, particularly in different text sizes.

If the graph you are working on becomes too messy, just press **OPTION** to return to the FUNCTION Menu and re-load a clean Image file. On your own, practice all of the size and color combinations, as well as using START for printer dumps and SELECT to save your work as an IMAGE file.

FONTS: SPECIAL AND CUSTOM CHARACTER SETS

A look at a directory listing on B/GRAPH disk #2, will show several files with the extension .FNT. These files contain character sets (FONTS) which you may load at any time and use in labeling Images. Some of the character sets available include. . .

COMPUTER: A typeface with a 'high tech' look.
FANCY: An elegant type style.
EUROPEAN: A collection of special characters that are found in the major European languages.
GREEK: Many of the special characters that are commonly used in science and statistics.
HEBREW: The Hebrew alphabet.
RUSSIAN: The Cyrillic alphabet.
INUIT: Eskimo script.
KATAKANA: Japanese script.
SIDEATAR: The Atari font, sideways.

The various typefaces may be loaded at any time by simply pressing the **OPTION + SELECT** keys simultaneously while an Image is displayed. (You must have the labeling mode turned off; no illuminated border.) The process is similar to pressing SELECT + START to change text size and color.

After pressing **OPTION + SELECT** you will be asked for the name of the font desired. You may do a file directory as usual. Simply choose the font you wish to use and it will be loaded from disk in a moment. You may now label your graph using these altered character sets. You may also return to the standard Atari character set at any time by selecting that choice from the menu. The special character sets may be used in any of the sizes or colors that B/GRAPH normally allows with standard Atari characters. (Some sets have only a few special characters which are displayed with CTRL or SHIFT and a certain letter.)

Note that if you press OPTION for the main menu and then Redisplay the Image, you will have lost the special font that you may have loaded and it will have to be reloaded. This slight inconvenience is necessary since otherwise you might find yourself typing a file name instruction in Hebrew.

You may design your own fonts and special characters and load them just as you do the ones that we have provided. Any of the popular character set editing programs such as SUPERFONT, THE NEXT STEP or FONTEDIT may be used. If you design or come across a font that you think that other B/GRAPH owners might like to share, please send it to us for inclusion in a later revision of B/GRAPH. If we use it, we will give you credit for its submission.

FONT ROTATION

Besides the ability to use any of the custom text fonts in any size and in any color when Labeling, B/GRAPH gives you the ability to place sideways text on your graphs with any type of font. You will find a font on Disk #2 named SIDEATAR.FNT. This is the standard Atari character set, built into the machine turned sideways. It is also possible for you to rotate any font of your choice. You may want to come back to this section of the tutorial at a later time to actually perform the steps involved. Here's how to do it.

If you do a directory of B/GRAPH Disk #2, you will notice a file called FONTROT.BAS. This is a BASIC program that allows you to take any of the fonts provided, or your own, and rotate them in 90 degree increments.

Before RUNning this program, you should use the DOS 'O' function to copy FONTROT.BAS and any fonts that you'll want to manipulate to a separate disk. Also move SIDEATAR.FNT. As mentioned, this is the Standard Atari character set, already rotated 90 degrees.

To use FONTROT.BAS, simply boot up your Atari with BASIC. Make sure on a one disk drive system, that you have the font that you want to rotate on a disk that has room as well for the new font. Type **RUN"D:FONTROT.BAS** and you will see a menu that offers two choices; Rotate a font and Exit to BASIC. Press **R** and the familiar B/GRAPH disk directory screen will be presented.

Select the font you wish to rotate and then when asked, give the name you wish to use for the

rotated font that will be produced. The process will start and lasts about 90 seconds. At the end you will have a font rotated 90 degrees from the original. If you do this again to the rotated font, it will end up upside down, and so on. You will find labeling with sideways and upside-down text a bit confusing at first, but the effect on your finished graphs can be quite attractive and worth the extra work.

LABELLING CONCLUSION

Using all of the special techniques shown thus far, create at least four different IMAGES. We will need that many IMAGES for use in the next section of the tutorial; Image Shows. We strongly suggest that you return for a while to both PIE CHART and GRAPHING and create a number of unique graphs that you can use for this next section and also to hone your skills in using the various modules.

THE IMAGE SEQUENCE CONCEPT

Since you can attach your Atari to just about any TV or monitor, including Large Screen Video projectors, you may find it convenient to display graphs and charts created with B/GRAPH to an audience. While calling up data files with GRAPHING or PIE CHART is possible, it is not terribly convenient.

Using the Review function to call up Imaged files is much quicker and more elegant, but requires the constant entry of file names and thus doesn't lend itself to presentations.

We have therefore included in this module of B/GRAPH the ability to both Create and display Image Sequences. You are provided with most of the functions of a good slide projector, including the ability to place the Images in defined sequences; set the number of seconds that Images will remain on the screen; skip forwards or backwards to an Image out of sequence or pause during a sequence.

CREATING AN IMAGE SEQUENCE

We assume in this section of the tutorial that you prepared a minimum of three Images and these reside on the disk in your primary drive. If you do not have these Images prepared, please return to GRAPHING or PIE CHARTS and produce them so that these instructions can be meaningful.

From the IMAGE FUNCTION menu, press: **Create a New Image Sequence**. The first question asked will be how many Images you intend including in the sequence. A standard single density DOS II diskette can hold 10 Images (10 × 66 = 666 sectors). Since this module is transportable to other DOS's, it is possible that you might wish to have four drives or use two double density drives. In any event, we have provided the ability to sequence up to 40 Images in one show, residing on up to four drives at the same time.

Enter the number of Images to be shown that you have prepared. You will then be asked for the number of seconds that you wish each Image to appear. If you type **zero**, then Images will remain on the screen until the next one is requested by you. For now, select **zero (0)**, but note that a minimum reasonable time for viewing an Image is at least 10 seconds.

The next query is for a name for this sequence of images to be shown. This is the file name that you will use later to call up the sequence. The instructions that you are giving B/GRAPH now regarding this sequence will also be stored to disk under this name. Call it 'SHOW.1'.

You will next be asked for the file name of Image one, then Image two and so on up to the number of Images that you had indicated were to be included in this sequence. If all the Images are on disk #1, then simply type in the names. If they are going to be on other drives, then please type in the drive number as well in the standard Atari manner, *ie* D2:PIC.1.

The Images DO NOT need to be on the disks while you are entering this sequence information. They must, of course, be on the correct disks, in the appropriate drives when the sequence is displayed later on.

After you have entered the last file name, the information that you have entered is saved to disk under the sequence name that you gave it. Since sequences take only a sector or two on the disk, you can have a great many different sequences of the same Images resident on one disk, although you are of course limited to the number of Images that may be stored on a single disk.

DISPLAYING AN IMAGE SEQUENCE

From the IMAGE FUNCTION menu, select **Begin an Image Sequence.** You will be asked to name the sequence. Enter the name that you gave our sample sequence (**SHOW.1**), and a brief message will appear indicating that pressing either **START** or the joystick button will commence the sequence. The screen will now go black and the Atari will wait until one of these is pressed before starting the show.

This feature allows you to set up a presentation sequence and remain ready to run it without unnecessary text on the screen. Of course you could always create a title graph using Custom Labeling and use that as your stand-by screen.

RUNNING THE SHOW

Press either START or the joystick button and the first Image will be displayed. You may now move forward to the next Image by pushing forward on the joystick or by pressing the letter '**F**'. To move back one Image in a sequence, pull back on the stick, or press '**R**' for Reverse. If you have set a time duration for each Image, the programmed sequence will run automatically, but you can interrupt the sequence clock by pressing the joystick button. Press it again to restart the clock and resume the show.

At any time during a sequence, you can press **ESC** and abort back to the FUNCTION menu. You also have the ability to randomly select Images out of sequence. To do this simply press the number of that Image in the sequence. For example, if an Image called PIC is the third Image in a sequence you can have that Image displayed at any time by pressing '**3**' while a graph is on the screen. You do not need to press **RETURN**. If there is a timed sequence running, it will be as if you had jumped ahead to that Image and the show will continue from there. Without the timer, you are free to move Forward or Backward or select any other Image number.

If you are using a double density DOS or have more than one drive, you are able to address Images 11 to 20 by pressing **SHIFT** and then a number. Image #10 is accessed by pressing '**0**', and #11 by pressing **SHIFT + '1'**, Image #12 is **SHIFT + '2'** and so on. The twentieth Image is addressed by pressing **SHIFT and '0'**. Images beyond 20 can not be addressed directly from the keyboard.

EXIT TO MENU

As with all B/GRAPH modules, you can move from the FUNCTION menu back to the main Program Selection menu by pressing **Exit**. Be sure that you have removed your working disk and inserted B/GRAPH disk #1.

This concludes the LABELING/IMAGE SEQUENCE tutorial. As with all B/GRAPH program modules, a bit of practice will help make all of the functions familiar.

FILE MANIPULATION

Oftentimes, you may find you wish to alter the order of factors in a data file, add in factors from another file and perhaps alter the data itself. This is in part what FILE MANIPULATION (number 5 on the main menu) allows you to do. It works on the data, not on a graph or Image. It also allows you to perform exponential smoothing and moving averages on your data and to save and load files in the VisiCalc (R) D.I.F. format or read ASCII files saved by other programs or by the CHI SQUARE SET UP program, discussed later. Since this program usually involves the alteration of data in your files, it is suggested that you go to Browse immediately after Loading a file and print the data by hitting the **START** key. This will give you a record to refer to as you go about making your changes.

LOADING AND SAVING FILES

By now you should know how to load and save files in B/GRAPH. Remember that if you want a disk directory simply hit **RETURN** in either of these modules and the directory will be provided. To continue and either load or save, press **RETURN** again, to go back to the main menu, press **ESC**. You must have a file loaded into memory to perform any functions in this program, so either use the Load, VisiCalc or ASCII options to get a file into memory.

EXPONENTIAL SMOOTHING

Exponential smoothing is a deceptively simple looking method, essentially a sales forecasting technique, although it can be used for other areas of time-series projection. It involves using actual prior sales (data) and the estimate of prior sales to project future sales. It works only on the first factor in a data file; other factors are destroyed in memory (although they remain in your disk file).

The formula for exponential smoothing is:

$$F(t+1) = a \times A(t) + (1-a) \times F(t)$$

where "t" is the time period, "A(t)" the actual sales in that period, "F(t)" the forecast or estimated sales and "a" the smoothing coefficient, explained below.

FIGURE 13

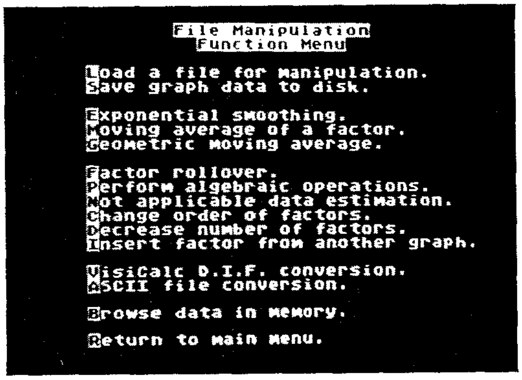
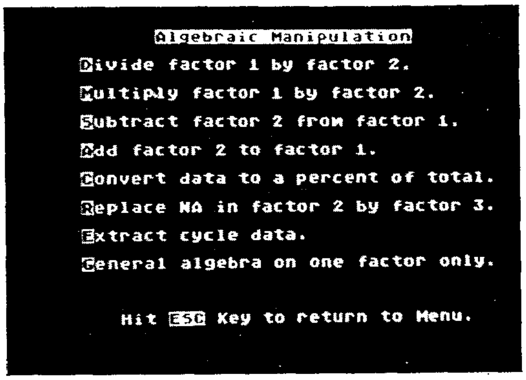


FIGURE 14



Since you need an estimate for the forecast to begin the process, you are given the option of entering a value or hitting RETURN which will use an average of the first five data points.

The Smoothing Coefficient is a value between zero and one, used to smooth the peaks and valleys in the data. The closer to one, the higher the emphasis placed on past actual sales. The closer to zero, the greater weight is placed on estimated sales. Equal weight is, as you might expect, .5. If you chose .1, then the formula would use 90% of what was estimated and only 10% of what actually happened. With a coefficient of .9, then 10% of the estimated value is used plus 90% of the actual sales.

Use the **L** command and load in the example file, ARM. Then use the **B** command for Browse

to examine the data. Remember that only the first factor will be used. The figures represent the amount of money spent, in $ billions, by the 113 developing nations of the world, on arms over a 20 year period. The other factors are arms exenditures in the 28 developed nations and total world foreign aid. Return to the menu and press **E** (not used for Exit here; **R** for Return is).

In response to the question for an estimate, press **RETURN**. For a Smoothing Coefficient, enter .5. The computer works and will shortly return a "Standard error of estimate". This value is the test of the closeness of the fit of the smoothed curve. The lower the value, the closer the fit. By experimenting with the smoothing coefficient, you will see what effect it has on the standard error. Mainframe programs usually solve for the smoothing coefficient that best fits the data, done by calculating the curves for every possible smoothing coefficient and choosing the best fit. Not only does this process take a long time, but seldom is this level of accuracy warranted. Instead, we leave it to you to find the most reasonable value for the coefficient. Commonly used values for the smoothing coefficient are .1, .3 and .5 with .1 and .3 being the two most common.

Exponential smoothing is best used on data which seems to fluctuate randomly about a given value, rather than data with a specific trend or seasonal variation, although it can still be employed for such data. It is also best for short rather than long range projections. A good combination can be obtained by using a moving average followed by exponential smoothing of the average data. In order to do this, you will have to swap FACTOR 1 and FACTOR 2 immediately after doing a moving average.

After you have performed your exponential smoothing, return to the data via **B**. You will see that the smoothing builds upon itself as it progresses down the data list. At the very bottom of the screen is the projection value for the next period.

MOVING AVERAGES

A moving average is an average done for a given number of adjacent data points in the first factor in a data file. It simply adds the values for the points within the period and divides the total by the number of points. The period must be an integer greater than one: you can't do a moving

average on .7 or −6 or similar numbers. Moving average works only on the first factor in a file; if you wish to use another factor, you will have to use Change to alter the order of factors.

If you have sales data for each month in a ten year period, you might do a moving averages of 12 months to examine average yearly sales. In this way, seasonal variations can be damped out and a better analysis of sales patterns maintained. The program averages twelve months at a time, dropping the earliest month in the list and adding the next month past the end of the current group to it as it progresses. This type of averaging is used for businesses with wide seasonal fluctuations in sales, seasonally adjusted unemployment figures, power usage and other areas where fluctuations occur.

For example:

Month	Sales	Moving Average
1	210	N/A
2	310	240
3	200	303
4	400	310
5	330	335
6	275	368
7	500	383
8	375	425
9	400	325
10	200	325
11	150	217
12	300	N/A

To get the averages (seen on the screen under the "smoothed" column heading), we add 210, 310 and 200 then divide by three. To obtain the next value, we add 310, 200 and 400 and divide the total by three.

The moving average used in B/GRAPH is centralized. This means that if you give a period of three months as above, you will get no average for the first and the last points; averages will begin at the second point. If the period of the moving average is even, B/GRAPH will adjust accordingly and move the second period further along automatically. The process involves doing a moving average for the period you give — say 12 — then another with a period of the same value but moved along one and then it averages the two to get the correct values. Those points outside the range will be marked N/A, for "not applicable". There simply is no data from which to give an average before nor after the figured points above.

Obviously, the period you give must be reasonably related to the data on hand. A seven month moving average will not give much useful information about a year of data, since the first and last three points will not be considered! Remember too that, while good for comparisons, a moving average is not used *per se* for a "what if" extrapolation.

The third column on the screen, once you have performed a moving average and have gone to Browse to examine the data, is RATIO. This is the percentage of the averaged (smoothed) data that the actual figures represent. If your sales were 310 and the moving average 240, the ratio would be 129.17, and if sales were 200 and the average 303, the ratio would be 65.93.

Moving averages are used to make forecasts, to identify seasonal components in the data or to smooth out the effects of random influences as a prelude to a projection of a secular trend, cyclical variation and seasonal variation. The data produced in the smoothed (*ie* moving average result) column and the ratio of the actual to smoothed may be saved with the first factor as another file and analysed in greater detail by other parts of B/GRAPH.

One defect of using moving averages in forecasting is that they do not generate a mathematical function for predicting future values. However, a regression analysis on the smoothed values and the ratio can be a powerful tool for that purpose.

GEOMETRIC MOVING AVERAGE

This is essentially the same as the moving average above except that it takes the values, multiplies them together and then takes the nth (n refers to the period of the moving averages) root. This is

most often used when a relatively constant geometric force is at work on the data; *ie* a definite trend line such as inflation. For example:

Year	Sales	Moving Average	Geometric Moving Average
1	100,000	N/A	N/A
2	110,000	110,333	110,000
3	121,000	N/A	N/A

As you can see, there is a difference in results; in this case, the geometric moving average figure is closer (exact actually) to the actual sales figure than the regular moving average. For another example, Load the file ARM and compare the results of a moving and a geometric moving average on the first factor. Also, change the period of the average to see what results with each different period.

FACTOR ROLLOVER

Especially in the case where you are using B/GRAPH for on-going business, it is useful to be able to add elements to either the top or the bottom of a factor without having to retype the entire file again. This module allows you to do Rollover; removing one or more items from a factor and replacing them with new values.

Your first question will be whether you want the items rolled off the top or bottom. It's a good idea to refer to your printed sheet of the original data to be sure which way you wish to roll off items.

The second question if how many items are to be rolled off. Obviously you cannot roll off more items than you have, although you can roll off an entire factor's worth. However, you will have to enter new values by hand in the correct order for each one you roll off.

Next you will be asked for which factor to roll off. You enter one, two or three. If you have

more than one factor to do this to, you will have to do each one separately, since we only allow you to perform rollover on one factor at a time.

Finally, after the computer has worked on a file, you will be asked to input the values for the new items. If you rolled off the top, you will be asked for the highest value first, then the next highest and so on until one. If you rolled off the bottom, you will be asked for the lowest first and then the next and so on until the last item is input. You may input a character but as normal in B/GRAPH, such input will be treated and appear on the screen as N/A. Note that the roll off feature allows you to examine data for lagged correlation (see Correlation Tutorial).

PERFORM ALGEBRAIC OPERATIONS

This is a particularly important and powerful portion of the file manipulation program, so use it with care. It allows you to alter your data mathematically by either choosing a pre-defined function from the sub menu or by entering your own equation.

The first four predefined equations we have provided are:

Divide factor one by factor two
Multiply factor one by factor two
Subtract factor two from factor one
Add factor two to factor one

These are straightforward arithmetical functions that perform exactly as indicated and the results of each action become the new values in factor one. For example, if you add factor two to factor one, the total is now in factor one. If you wish to perform these operations in a different order or on different factors, you will have to use the Change order of factors module, discussed further on. To see the results, return to the main menu by pressing **OPTION** and then choose **Browse**.

Convert data to a percent of the total is also quite straightforward; it converts each item into a percentage of the total of all factors. For example, if you have three factors with item number

Factor 1	Factor 2	Factor 3
10	20	30

You would get these numbers added together for a row total of 60 (not shown) then calculated as a percent of that total. If you checked the data by using the Browse function, you would now see it reading as:

Factor 1	Factor 2	Factor 3
16.67	33.33	50

We do not add up columns (factors) to get the total value for all of the elements in a factor and then give you a percentage based on that total. The percentage is based on the total of a row. Therefore, if you have only one factor, you will get 100 for every element, because it is 100% of the total!

EXTRACTING A CYCLE

You may find it necessary from time to time to take a data file previously created and to extract certain data that occurs on a cyclical basis. For example, if you had several years worth of data consisting of monthly sales figures and then wished to graph and analyze the figures for each March, rather than having to do so by hand you can use . . .

Extract cycle data.

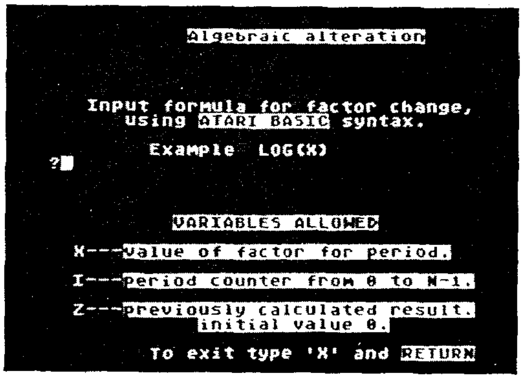
This command is found in the Algebraic Operations section and works as follows. You will be asked for the starting period (you would enter 3 for March in the above example if March were the third item) and then the cycle, which in the case of calender months would be 12. B/GRAPH will then create a new file with only the data for every twelfth item, starting with the third. You may now save this Extracted data to disk and then use it to create a new graph.

GENERAL ALGEBRA ON ONE FACTOR ONLY

This selection allows you to perform complex algebra on one factor at a time. You may alter all of your factors in this manner, but each must be done separately.

You may input any valid BASIC equation such as SIN(X) or LOG(X) + COS(X)/2.5, including Boolean logic. Refer to your BASIC manual to see what is valid and what mathematical functions Atari BASIC supports (it does not, for example, support TAN). If you simply input a single number such as 25 or 6, it will make all items in a chosen factor into that number.

FIGURE 15



We have listed the three legal variables below the input line these are:

X — this is the item or element to be worked on. If your first item is 10 as in the example above, then SIN(X) will be SIN(10).

I — this is the counter for the number of items in a factor, starting from zero and counting up to the number of elements minus one. This is useful for performing incremental adjustments. For exam-

ple, if your factor has five elements of value 10 in each one, then the formula XI would give you results of 0, 10, 20, 30 and 40. Remember that the first value for I is zero, so $10 \times 0 = 0$.

Z — this is the previously calculated result, initially zero. This is useful when incrementing a factor by an amount related to the previous result such as interest rates. With a factor of five elements, all ten again, the formula $X \times I + Z$ would produce the results of 0, 10, 30, 60, 100, 150 respectively.

You will then be asked to which factor you wish to perform the function that you have chosen. You may enter a factor number (you will get an error message if that factor does not exist) or you may press ESC to return to the menu. Once the computer performs the function, it returns you to the menu and you must choose Browse to see the results.

The general algebra function has many uses. For example, to convert degrees to radians, you would enter $3.141593 \times X/180$. To see a 5% discount of money (annually deposited) you would use Z + X/1.05^(I + 1). In the same manner, to accumulate money at 5% interest where each element is the deposit in the account for the year, you would use $Z \times 1.05 + X$. Factorials can be done up to a maximum of ten elements by using $Z \times (I + 1) + (I = 0)$. To get a running product where item one is itself, item two is item two times item one, etc, use $Z \times X + X \times (I = 0)$. For a running sum, simply use $Z + X$.

As another example, if you wanted to see the balance outstanding on a 20 year loan at 10% interest, Initial amount $100,000 and an annual repayment of $11,745.96, you would make a file of 20 elements, all zero (the value doesn't actually matter here since we don't refer to it in the calculations). Then to get the balance each year, use the formula:

$100000 \times (I = 0) + Z \times 1.1 - 11745.96$

CHANGE ORDER OF FACTORS

This is quite simple; it allows you to make one factor any other factor in memory. You cannot make factor one into factor three if you only have two factors to begin with (an error message will result from trying). To do that, you will first have to use the Insert function, discussed below, in order

to increase the number of factors to two or three.

You will be asked which factor is to be the new factor one, then two and three if you have that many in memory (it's pointless to perform this function on a one factor file . . .). It is possible to replicate a factor by having it as factor one and two, for example. This might be useful before performing algebraic operations, in order to retain the original data in another factor.

ESTIMATING NON-APPLICABLE DATA

The File Manipulation program module offers you two separate methods of estimating missing data. An example of such a requirement might be an instance where experimental data was lost and you wish to interpolate what that missing data might have been.

On the main File Manipulation Menu screen there is the selection . . .

Not Applicable Data Estimation

When N is selected, you will be asked which factor is to be worked on. Choose a factor and B/GRAPH will insert estimated values for any data points that contain NA in that factor. This estimation is performed with a simple linear interpolation. There is a more accurate form of interpolation available but it requires a bit more work. This is done as follows.

Under the Perform Algebraic Operations option you will see the command . . .

Replace NA in Factor 2 by Factor 3.

When doing a Regression on a data file (to be covered shortly in the Tutorial), you will find that B/GRAPH creates a new third factor which contains the calculated values. If your data contains any NAs in Factor 2, by using this new command you may automatically replace any such Not Available (or Available) data points in Factor 2 with values from the calculated Factor 3. Once you have had an opportunity to learn how Regression works, the applicability of this feature will become apparent.

DECREASE THE NUMBER OF FACTORS

Again, this is a fairly simple function. It will reduce the number of factors in a file by eliminating in memory the highest number of factor(s) above the number you wish. You will be told the number desired. If you have three and you wish two, then the third is wiped from memory. If you had wished just one, then both two and three would have disappeared.

Use this function with some caution: once decreased, you cannot increase the number of factors except by using the Insert function, discussed below. It eliminates the last factor(s), so you may have to use the Change order function first if you wish to eliminate factor one rather than three.

INSERT A FACTOR FROM ANOTHER FILE

This is particularly useful when you need to either exchange the data in a factor in memory for that in another file or to increase the number of factors in the file in memory. You will be asked to give a file name for the file on disk. Hit **RETURN** by itself to get a disk directory.

The file will be loaded when you give its name and you will be asked which factor in that file you wish to insert. A buzzer will sound if you ask for a non-existent factor. You will then be asked to input the factor to be replaced in the file in memory. If you have one factor only, you may make the new factor either one or two. You cannot make it factor three if you have only one to begin with. Similarly with two or three, you may make it one, two or three. This and the Update function (in GRAPHING and PIE CHARTS) are the only ways you can increase the number of factors in B/GRAPH. You may then Save the file to disk if you wish.

If you wish to increase a one factor file in memory to a full three factors, you will have to use the Insert function twice; once to add factor two and again to add factor three. A feature of B/GRAPH is that both files need not be of the same length. If the file being added has more data points than the file in memory the excess will be dropped and if it has less data, then the file will be padded with N/As.

VISICALC D.I.F. CONVERSION

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One of B/GRAPH's features is its ability to load and save files in the VisiCalc (R) D.I.F. format, also used by Syncalc(TM). This gives you the ability to visually illustrate your VisiCalc files with our graphs and to use the B/GRAPH files in your VisiCalc calculations.

When you use VisiCalc, you are given the opportunity to save your data by row or column. You should save it by whichever manner you have it listed on the screen, so if you have three columns of thirty elements, then save it by column and if you have the same data in rows, then save it by rows. B/GRAPH will read in the data as factors one, two and three, in that order. B/GRAPH does not send or return labels to a D.I.F. file.

To Load a VisiCalc file, you simply enter the filename (hit **RETURN** alone for a disk directory). VisiCalc files have the DIF extension on them. If you neglect to add the extension to the filename, then B/GRAPH will add it for you. Once loaded, you may manipulate the data in the same manner as any file in memory and save it again as either a B/GRAPH file (using the Save function in the program menu) or as a VisiCalc file, as described below.

To Save a file in the VisiCalc DIF format, simply hit **S** in this module and provide a filename. B/GRAPH automatically adds the DIF extension on the filename if you leave it off. You may then load your file into VisiCalc by row or by column as desired. Refer to the VisiCalc manual for further information.

ASCII FILE CONVERSION

This function allows you to Load an ASCII file into memory, either produced by your own program or by using the Chi Square Set Up program, described later in the documentation. You may then save the file as a B/GRAPH data file using Save in the function menu. You may also save a B/GRAPH file as an ASCII file in the same manner as a DIF file.

ASCII files supported by B/GRAPH have a limited amount of data in them that can be read by this function. Their structure is as follows. They must have as their first element, the number of factors (maximum three), then the number of data points in each factor (one number only), followed by a sequential list of the elements for each factor in order (one, two then three).

ASCII files can have no labels or factor names, simply the raw data. You can add all of these items once you have Saved the file, by returning to the Main menu using Return and choosing 2, Graph. The Alter graph labels will allow you to add labels as necessary.

BROWSE

Browse simply allows you to examine the data you have in memory, not change it. You will notice that we have rounded off the data to two decimal places, since the most common use for much of the functions in this program is financial. To print the data, press the START key.

RETURN TO THE MAIN MENU

Once you have done with your file, you may return to the main menu by pressing Return. If you have data in memory, you will be given a change to save it or to continue to the menu.

STATISTICS

INTRODUCTION TO THE STATISTICAL PACKAGE

Statistics and statistical analysis are not subjects easily explained in a few lines, nor is it really the place of this tutorial to explore the depth and intricacies involved in the topic. However, far from the dull and mundane task it may appear to the uninitiated, statistics can be a fascinating, highly informative study for anyone with even the mildest interest in cause, effect and relationships of data. We assume that the reader has at least a modicum of such interest already, otherwise they wouldn't have purchased a program like B/GRAPH.

When we use the word "statistics", we are referring to one of four meanings for the word: the subject or discipline, secondly as methods used to collect or process or interpret qualitative data, thirdly as the collections of data gathered by those methods and finally specifically calculated figures such as an average or a coefficient. You will see examples of this in the descriptions below, making it much easier to appreciate the uses of the different functions in this package. Once again, the reader is recommended to those books in the bibliography and outside for a deeper appreciation of the whole range of mathematical and statistical analysis topics.

There are actually four programs associated with our statistical analysis package: Statistical analysis (number 6 on the main menu), Regression (number 7), Correlation analysis (number 8) and Chi-square set up (number (9). Moving averages and exponential smoothing, plus algebraic manipulation of factors, is performed in the File manipulation program, number 5 on the main menu (discussed previously).

This part of the tutorial will follow each program function in the menu order. This may be somewhat confusing initially, but should be clear once read through.

WHY WE USE STATISTICAL FUNCTIONS

"Figures can't lie, but liars can figure".

That old saw is quite apt here. It is very easy to draw seeming relationships between unrelated data and assume that they are in some way correlated. For example, in the 1960's, there was pointed out an inverse relationship between the amount of milk consumed and the number of drug addicts around, the tongue-in-cheek message being that if you don't drink your milk, you become addicted to something or another.

It is also quite easy to make inaccurate predictions based on existing data because the projection curve (regression) was not appropriate for the data presented, or there was not enough data available to make accurate predictions, or outside forces were not taken into consideration. For example, pundits often use regression curves to predict the number of home microcomputers which will be sold in this continent during the next decade or by the next century. As a simple linear curve, we end up with some billion-odd computers sold by the very early 21st century. Nice outlook for investors and manufacturers, but so obviously unrealistic. No account is taken of a limited number of people to buy, no account of income restrictions, no account of market saturation. Unless of course, it is intended that we all have three or four of them.

There is also danger in trying to interpret data for which the samples have been force-fitted or biased by some means or another. One Canadian university did a questionnaire on whether or not students were more sexually liberated than their parents and their samples suggested a strong YES answer. However, doubt was cast on the validity of the study when it was learned that all of the sample people questioned were in the university's birth control clinic at the time! This adds a significant bias to the result, needless to say. Results of this nature were the cause of Benjamin Disraeli's exclamation: *"There are three sorts of lie: lies, damned lies, and statistics."*

Statistical analysis — an essential tool in science, industry and commerce — may be considered a manner of applying mathematical rigor to things we do all of the time, but about items for which we have no feel. Now, when the car salesman says the vehicle in question has only 2,000 kilometers on it and it was only driven by somebody's grandmother to church on Sundays, it's likely you won't believe him. You have applied a statistical hypothesis test to the data and

found it highly unlikely to be true. You may not think exactly that there is a 5% chance that he may be correct and a 95% chance that it's all hogwash, but you have come to an analogous decision nonetheless.

THE NULL HYPOTHESIS

Statistical inference usually involves setting up a hypothesis (the "null" hypothesis) and testing it against an alternative hypothesis: the car actually was driven by a little old lady or A.J. Foyt is a grandmother. Hypothesis testing has a threshold value below which it is rejected. In our case above, we might accept the car if we felt the story had a 50% change of being true. This probability of the truth where we make our cutoff is referred to as the level of significance. A null hypothesis is usually that the population mean equals a certain value (500 heads for example) or that the standard deviation is equal to a certain amount.

In another example, say we toss a coin 1000 times. We expect 500 heads to result, assuming the coin is unbiased (our null hypothesis). If we want to reject the hypothesis of a true coin with a 5% level of significance, then we would reject the coin as unbiased if we get less than 470 or more than 530 heads. Only 2.5% of the time would we get results less than 470 if the coin were unbiased.

A range on both sides of the expected value is a "two-tailed" test. We normally use a one-tailed test. For example if we bet tails, we would be pleased if we got too few heads, but would reject the hypothesis if we got 526 heads as unbiased towards heads. The probability of getting 531 or more heads is only 2.5% but 526 or more is 5% and 516 or more is 16%.

In the same manner, were you a manufacturer buying wire from another source, you might accept one defect every 1000 meters of wire. In a random test, you find three defects in that distance. Since you have no "feel" for wire quality variance, you would instead apply a test to determine the possibility of finding such a sample at random. If, when factors are entered, the result turns out to be, say, 40% or greater you would believe that the sample fell within a statistically acceptable region. You would probably go back to another random sample (or even more) to apply this test enough times to get a reasonable database for your projections.

ERROR TYPES

As you can see, there are no sure things. If we test at a 5% significance level, then we reject a hypothesis which is true once in every 20 times. This is called a type one error.

A type two error is harder to measure. That is accepting the null hypothesis when it is actually false: the coin may be weighted to fall tails-up more often but we don't know it. We might accept it at 470, assuming the mean was 500 but what if the mean was actually 400? The probability of a type two error can only be estimated if the deviation in mean acceptable is known. The best way to minimize this kind of error is to increase the sample size.

This part of B/GRAPH is perhaps the most difficult to explain to the uninitiated. While it's generally true that if you don't know what the function is, you don't need it anyway, you may discover that once you understand the purpose, you may be able to apply it to your data. We cannot present a complete tutorial on statistics here; we can only gloss over it and recommend that you read up on it on your own. A small bibliography is provided at the end of the documentation for that purpose.

One of the most important techniques to familiarize yourself with the statistical portion of B/GRAPH is to experiment with it. Try creating data files with data you know is related and then applying regression and statistical analysis to it to see the results.

By the time the reader has reached this particular place in the tutorial, we make certain assumptions about their understanding of certain functions in B/GRAPH. We assume you know how to Save and Load a file, how to print documents and call up data screens and return to function menus by using the special Atari keys, how to change color effects in a graph, rescale graphs, call up a disk directory and the other functions generic to all B/GRAPH program modules. There are specific terms we use — factor, data file, data point, etc — which we also assume you understand by now. We will touch on these only lightly in the following material rather than repeat ourselves ad infinitum. If you do not understand these basics, we suggest that you either return to the earlier descriptions and reread them or turn to the command summary at the end of the reference section.

NOTE

For those who are familiar with statistics, we apologize for our lack of mathematical rigour and exactitude. We have attempted to simplify a complex area for the uninitiated and in doing so have left off some of the more mathematical niceties.

T-TEST

The first part of the STATISTICAL ANALYSIS program (option 6 on the Main Menu) is the t-test. The t-test (or t-distribution test, also called the Student's t-test) is a test of the probability that two samples came from the same population. Populations are larger groups of things, people, data, numbers or the like. Samples are sections taken from a population from which certain observations are made and used to infer general information and trends about the population. We use the sample to get an estimate of the population mean (the mean is the linear average: the total of all of the elements divided by the number of elements).

The t-distribution is a family of curves, similar to the normal distribution curve (a bell curve) but flatter and more dispersed. The t-test based on this distribution is used to analyse whether or not your two samples share enough in common to actually come from the same population; or if it is reasonable to assume that the two samples have the same mean. The t-distribution is a bell-shaped curve symmetrical about a mean of zero. It has a standard deviation dependent upon the sample size. As the sample size increases, the t-distribution curve approaches that of a standard normal curve (see below). The t-test assumes that each sample has a similar dispersion, or roughly put, range of data points. It is normally used for samples of less than 30 elements each. For larger sample sizes, we would use the normal distribution probability, below. The larger the sample, the closer the shape of the t-distribution curve approaches that of the normal curve. With a t-test, the smaller the sample, the larger the difference between elements in a factor is demanded. A big difference is needed to establish a significance if the samples are very small.

To examine how this works, use the Load command in the function menu to load the file PLANET, then press T. In answer to the questions on the screen, press 1 for test samples in memory. In a moment the computer will give you back an analysis of the closeness of the first two factors in your data file. The factors do not have to have the same number of elements in each; the program is smart enough to recognize N/A's and will treat factors with differing numbers of elements as having different degrees of freedom.

FIGURE 16

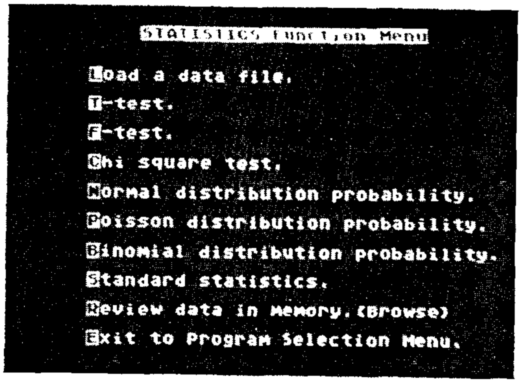
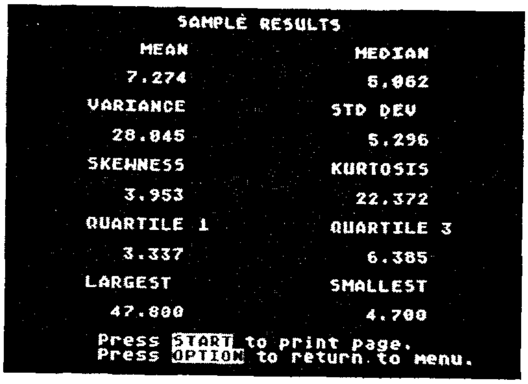


FIGURE 17



The screen shows the analysis for both factors. If you had only one factor in your file, you will not see these summaries on the screen. With one factor only, it will ask you for the value of the mean you wish to test. It will calculate the t-value and the percent above, mentioned further below. You can do a t-test for one factor as well as you can do a test for two.

DEGREES OF FREEDOM

The first statistic is "Degrees of Freedom". This is a somewhat confusing number, representing the number of classes or values in a set which can be taken arbitrarily. We use it to reduce the artificiality of the way we make the sample and the mean fit our estimate of the population. It is generally the number of elements in your sample less one for every statistic you calculate (in this case one, for the t-distribution) using the sample values. Since we have data points for ten planets (or nine and one asteroid!), we reduce it by one to get nine degrees of freedom. If our sample had 100 points, we would have 99 degrees of freedom here.

VARIANCE

The next statistic is the "Variance". This is the square of the standard deviation, a measurement of the deviation of a sample about its mean, taken as the mean of the square of the deviations. For example, if we had five items with the weights 111, 114, 117, 118 and 120 grams, by adding them together and dividing them by the number of elements (five), we would arrive at a mean of 116. The items would deviate from 116 by −5, −2, +1, +2 and +4 respectively. If we add up the deviations, we'd find that they logically add up to zero. So instead we square the numbers, thus disposing of the negative signs: 25, 4, 1, 4 and 16. Now if we take the mean of these new values, we get the Variance; in this case 50 divided by 5, or 10. To return to the same units as the original measurements or observations, we take the square root of the Variance; 3.16 in this case. If your numbers are very large and have a large dispersion between values, the Variance might become too large for the computer to handle properly. In this case, you will get N/A (Not Applicable) for your answer.

MEAN

The mean, our next number, has already been explained as the total of all values in a factor, divided by the number of elements. This is what most of us think of as an "average".

T VALUE

Your t value is the number representing the chance that the two samples were from the same population. It has a range of any positive value but will most normally be between one and ten. The significance of this number depends on the number of degrees of freedom involved. The more the degrees, the lower the t value need be to establish a significant relationship between the two samples. As a general rule, the higher the value, the less the chance the two samples were from the same population.

PERCENT ABOVE THIS VALUE

The "percent above this value" on the bottom line is the percentage chance that a given value will lie above the curve for the t-value; *ie* how often will you find a sample of the same size with a

difference in means greater than the difference you have in these two samples. This is a single-tailed test; we are only testing one end of the curve, so the percentage is never larger than 50%. If it is very large, then there is a very good chance that the means come from the same population; the chance is smaller the smaller the percent. It's an inverse relationship with the t-value.

TESTING SPECIAL VALUES

If you have no data file you wish to test, you can choose the second category on the first screen: Test special values. The program will go straight to this category if it finds nothing already loaded into memory. For this you must enter the number of degrees of freedom and a number for the Student's t elements you would find above the computed values, as in the above example with a loaded data file.

F–TEST

The F-test, or F distribution test (after British statistician R.A. Fisher), like the t-test, tests if two samples came from the same population. However, it asks the question "are there significant differences anywhere among these samples?", and uses a process called the "analysis of variance". It needs two samples to work on, although it is most commonly used in a larger framework with three or more samples to work on (B/GRAPH can only work on the first two factors in a data file). It is a skewed distribution, starting at zero, involving a comparison of two variables. It is determined by its degrees of freedom and is usually formed by dividing two independent estimates of variance in order to test equality of the variances.

Since you divide one sample variance by the other, you have two degrees of freedom: one for the numerator (the number being divided) and one for the denominator (the divisor). This leads to a great many possible curves. The distribution is not symmetric, so one cannot determine the left portion of the curve from the usual tables. To alleviate this, the larger variance is placed on the top when dividing.

You can still use the data in memory loaded for the t-test by pressing 1 or you can return to the menu and load in a data file. The F-test will provide you with the degrees of freedom, the

variance, and the mean as before in the t-test; the same values if you use the same file or data. It will however, now give you a value for the F-test and a percent chance the data will lie above this value. Like the t-test, the factors you test do not have to have the same number of elements; if they have N/A's in them, they will be treated as having different numbers of degrees of freedom. A method of using the Regression Program as a replacement for the F-test when you have more than two factors is described later.

TESTING SPECIAL VALUES

Should you have no data loaded or wish to do a test of special values, enter 2. You must now supply the degrees of freedom in the numerator and again in the denominator. You will have to supply an F-value and the result will be the percent chance that a sample element will be above, or worse than, this value.

CHI-SQUARE TEST

Another distribution test, the Chi (pronounced "kye" as in sky) square distribution is related to the t distribution (actually it's the square of the t distribution), described above, using two factors for analysis; the actual data and the expected data. It is used to test the goodness of fit of two sets of data; *ie* how a result fits to an expected value. The value is the sum of the square of the actual minus the expected values, divided by the expected. In any Chi square, the mean is equal to the number of degrees of freedom in the sample.

The Chi square test is one of the most widely used tests in social statistics. The size of the Chi square value depends, loosely, on the sizes of the differences between the two factors (actual and expected) and on how many differences are involved.

To use this part of the program, you may load a data file with one or two factors (a third factor will be ignored). If you have only one factor, the program will ask you for the degrees of freedom for it then a Chi square value from which to test your data. You will be given the percent as above, for the data on hand and the degrees and value entered. The same questions will be asked of you for the second choice, test special values.

If you have two factors, then the program treats the first as the observed or actual results and the second factor as the expected. It will only ask for one degree of freedom and it will return the Chi square value as computed and the percent described above. Unlike the t-test and the F-test, both factors must have the same number of elements without N/A's.

Due to limitations of both the Atari and B/GRAPH, this program can only handle two factors; a two-column matrix. Frequently, a Chi square test is done on a matrix of considerably larger size, used as a test of the principles of classification. In order to overcome this, we have provided a separate program called CHI SQUARE SET UP which will allow you to write out a large matrix which is then turned into two strings for use in the Chi square function here. More on that program later.

NORMAL DISTRIBUTION PROBABILITY

Normal distribution is just that; it's the curve of distribution found in nature. It is also the basis of sampling theory, which concerns itself with establishing relationships between population distributions and those of the sample statistics.

If you pick a sample from a normally distributed population, it may not itself be normally distributed. However, an interesting theorum called the "central limit theorum" states that if we take repeated samples of the same size from a population, the means of the samples would themselves tend to be normally distributed even if the underlying population is not normal. It's the result of this theorum that allows relatively small samples such as the Gallup Poll to be accurate for a large population.

Normal distribution is the familiar bell curve used in mapping large populations and frequently scoring examinations in schools. The curve is such that 34% of all elements fit between the mean and one standard deviation to each side: therefore 68% of the total are said to be within one standard deviation. For example, if in a population, the mean of weights was 80kg and the standard deviation was 10kg, 68% of the population data would fall between 70 and 90kg. Furthermore, 95% lie within 1.96 standard deviations of the mean and 99.75 of all observations lie within three standard deviations. The sample mean and standard deviation is an estimate of the population means and standard deviation.

The normal distribution curve never reaches zero at its ends, so between the mean and infinity is 50%. What this program measures is the percentage of the data which will fall between the mean you give it and the test value you enter. You must give it a standard deviation when asked, before entering a test value (for this test you don't have to load a data file; it works only on one test value at a time). For example, if we have a mean of 150 and a standard deviation of 15, what is the percent of the population which will lie between the mean and 180? The result will be 47.724. By simple arithmetic, this means that only 2.276% of the population will lie above this test value. You can manually convert your data to the standard normal curve by subtracting the mean from the test value and dividing by the standard deviation. In this case the result is two and the value on the table is 2.28%. However, B/GRAPH was designed to do all of this for you without the manual arithmetic.

Generally, you use the normal distribution when you know the standard deviation and the test sample exceeds 30 and you have reason to believe that the sample standard deviation is a good estimate of the population standard deviation.

POISSON DISTRIBUTION PROBABILITY

Say you were buying guitar cases and had a contract which stated that you would accept 12 defects every thousand as reasonable. In your random test, you will find 15 defects in 1000. Rather than run screaming to the manufacturer, you do a simple Poisson test to find the probability of discovering 15 defects when only 12 were expected.

When you choose P, you don't need to load a data file, merely answer the questions as to the expected frequency of events or values (12 in our example). Then answer with a test value (15 here). The result will be the percentage chance of finding exactly that many occurrences. Our answer is 7.239%. Usually we don't start screaming until we get a value of 5% or less. To see what our chances of getting say between 15 and 18, we would enter 15 as the lowest number and 18 as the highest. In some respects, this is similar to the binomial distribution, discussed below.

You use the Poisson test when you have very low expected frequencies rather than large ones. Remember, it works on an EXACT occurrence, not a value larger or smaller than your test frequency.

BINOMIAL DISTRIBUTION PROBABILITY

Have you ever played a game of chance such as dice where you wondered what were your chances of getting a certain result? What you wanted to know was the binomial distribution probability.

Let's look at a simple example: tossing a coin. By rights, you have a 50/50 chance of getting either side, since there are only two sides to a coin. This would be stated as a .5 probability of success (in a range from zero to one). If you tossed it ten times (your number of trials), you might like to know what the probability of getting exactly five heads (successes they would be called) were, using this function, we enter these values at the prompts and get a probability of success of 24.609% for exactly five successes.

But what does that tell us? What about five successes or less? If we are gambling, we may be interested in a spread of numbers. Well, if you do a bit of finger work, you will get the values below for a .5 probability of success and ten trials:

SUCCESSES:	
0 or 10 —	.098
1 or 9 —	.977
2 or 8 —	4.395
3 or 7 —	11.719
4 or 6 —	20.508
5 —	24.609

You might notice that there is a curve of data here, with five at the peak and all other value sloping away towards zero on each side. The total should add up to 100% (it adds to 100.003 due to the rounding to three decimal places). Without B/GRAPH, if you wanted to know the probability of getting five or less, then you would add together the probability values for the numbers less than your anticipated success rate, in this case five plus four plus three plus two plus one plus zero (.977 + 4.395 + 11.719 + 20.508 + 24.609 + .098) and you would get 62.306, or 62% chance of getting five of fewer wins.

B/GRAPH makes this somewhat easier; you supply the range of successes; the lowest first and the highest second. If you want the range for the test above, you would enter zero and then five. If you want simply the chances for one factor, enter it as both numbers (*ie* five and five).

When you have more than an expected of 35, you can use the Normal distribution rather than either Poisson or Binomial distribution. However, you need to calculate the mean and standard deviations. For Normal distribution (a test of more than 35 expected successes), the mean will equal the number of trials times the probability of success, in our example .5 × 10 = 5. The standard deviation is the square root of the mean times one minus the probability of success, in this case SQR(5 × (1 − .5)). For Poisson distribution (where the probability of success is very small, for example one in one million), you calculate the mean in the same manner (probability times the number of trials) and the standard deviation is merely the square root of the mean.

STANDARD STATISTICS

This portion of the program performs a number of common statistical functions and provides some of the most commonly used statistics, derived from your data files. It works only on data in memory from a loaded file, not special values you input. Standard statistics works on the first two factors in your data file. If there are two or more factors, it assumes they are grouped data; that is related in such a way that if you were, say, testing samples of smokers and the first elements in each factor were 17 and two, it would group them to mean that 17 smokers had two cigarettes rather than assuming you had samples of 17 and two smokers. If there is only one factor, then it is still treated as group data, but with a group size of one.

MEAN AND MEDIAN

Ten statistics will be produced by this program, some of which will be familiar to you by now. The first two are the mean and the median. The mean is the linear average: the sum of all of the elements divided by the number of elements added. This is the popular "average" we often use. The median is also an "average" of a different sort. It is the number at which 50% of the observa-

tions lie above (and therefore below). For example, if we have the following test data in a file:

25, 22, 3, 4, 2, 3, 1, 5, 6, 3

We would see that the mean was 7.4 but the median was only 3.5; half of the observations lie below 3.5. If these were salaries in a company, in $10,000 units and they boasted an average salary of $74,000, you would ask for the median to see that the real half-way point was $35K.

VARIANCE AND STANDARD DEVIATION

The next statistics are variance and standard deviation. Variance is the square of the standard deviation. The standard deviation was explained earlier; it is simply a measure of the variability of the data. For the sample above, the mean is 7.4. The observed data deviates from this value by:

17.6, 14.6, −4.4, −3.4, −5.4, −4.4, −6.4, −2.4, −1.4 and −4.4

The variance is the sum of these deviations squared, divided by the number of deviations added:

$$309.76 + 213.16 + 19.36 + 11.56 + 29.16 + 19.36 + 40.96 + 5.76 + 1.96 + 19.36 = 670.4/10 = 67.04$$

This number is the variance for that particular sample. Its square root, the standard deviation is 8.188. What we see on the screen for variance, however, is 74.489. This is the variance multiplied by the number of elements divided by the number of elements minus one ($\times n/n-1$) and the standard deviation is actually the square root of this value: 8.631. Why have we done this? Because we assume that the factors represent samples of a larger population as opposed to the entire population itself. So what we have done is improve the estimate of the population variance by "unbiasing" the variance with the multiplication above. The reason for this is best explained in a standard statistics textbook, but it is legitimate.

The effect of our "unbiasing" becomes less pronounced the larger the sample size. Multiplying a number by 100/99 gives a value closer to the original than multiplying it by 4/3 would.

SKEWNESS AND KURTOSIS

The next two statistics — skewness and kurtosis — relate to the nature of the curve itself. Skewness is a measure of how far the curve is skewed to the left or to the right. A positive number indicates a skew to the right, a negative number a skew to the left. The range is infinite but the larger the absolute of the number, the larger the skew.

Kurtosis is a measure of the peakedness of the curve. A normal curve would have a kurtosis of 3. Less than that indicates a flatter curve, greater a steeper curve. Our example has values of −.114 and 1.846, indicating a slight skew to the left and a flattened curve.

QUARTILES AND RANGES VALUES

Quartiles one and three are the points at which 25% and 75% of the observed data lie below, respectively. The median is actually the second quartile. In our example, the first and third quartiles would be 3.00 and 6.00.

The largest and smallest values are simply the two numbers in our data which represent the range of values; largest and smallest.

REVIEWING DATA

You may find it useful during your statistical functions, to check what you actually have in memory. For this, use the Review command from the function menu. If you only loaded one factor from a data file, you will still see two factors in memory; the first factor will simply show "one" for every element. This is because we use group data and in a one factor file, every group is given a size of one by B/GRAPH.

AN EXAMPLE

Suppose we have ten cars, examined on the assembly line for defects. The results are:

Car#	Defects	Car#	Defects
1	2	6	8
2	1	7	2
3	4	8	1
4	3	9	3
5	4	10	2
		Total	30

The mean or average is three defects per car, written as "X". The median is 2.5, determined by sorting the numbers in increasing order and determining the number for which 50% of the observations lie above and below. This is between the 5th and 6th car when sorted (half of 10). Now look at this table:

Car	D	X-D	$(X\text{-}D)^2$	$(X\text{-}D)^3$	$(X\text{-}D)^4$
1	2	−1	1	−1	1
2	1	−2	4	−8	16
3	4	1	1	1	1
4	3	0	0	0	0
5	4	1	1	1	1
6	8	5	25	125	625
7	2	−1	1	−1	1
8	3	0	0	0	0
9	3	0	0	0	0
10	2	−1	1	−1	1
Totals	30	0	38	108	662

The first and second columns are the same as before. The third is the difference between the mean and observed value. The following columns are the third squared, cubed and to the fourth power respectively. The third column totals zero, since by definition, the sum of the differences about the mean must be zero.

The fourth column is used to calculate the variance: we divide the sum by 10 for a value of 3.8, getting a standard deviation of 1.95.

Skewness is calculated from column five, using the formula:

$$(108/10) / (3.8)^{3/2} = 10.8/7.40756 = 1.458$$

If the function was symmetric, this value would be zero. The value here indicates skewness to the right.

Kurtosis is calculated from the sixth column by:

$$(662/10) / (3.8)^2 = 66.2/14.44 = 4.584$$

The normal curve has a value of three for this measure, so this value indicates a more peaked curve.

EXIT

To return to the main menu, type E.

REGRESSION

INTRODUCTION

Regression is the process of fitting a mathematical curve to a set of data points. In B/GRAPH, this works on the first two factors in a file; placing the first factor along the X axis, the second the Y. Regression will ignore N/A's. If you have only one factor, then it becomes the Y and the X is a simple numerical increment up to the number of data points (*ie* 1,2,3 etc). You might use a one factor data file to project data for, say, monthly sales where the time series is just such an increment (time being an implicit variable with sales an explicit variable).

The data should have some relevant relationship to each other in order to make a meaningful curve. A factor with points randomly fluctuating between zero and 1000 does not relate well to a geometric progression from 900 to 2600. It can be graphed, but little information will be gleaned

FIGURE 18

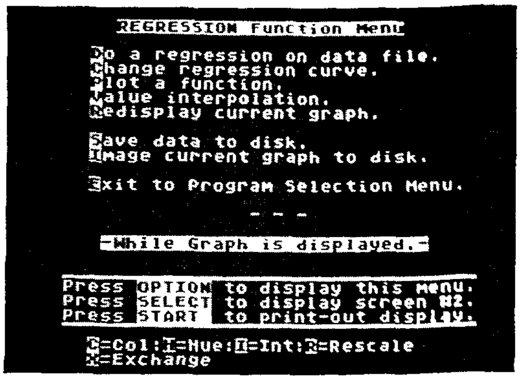
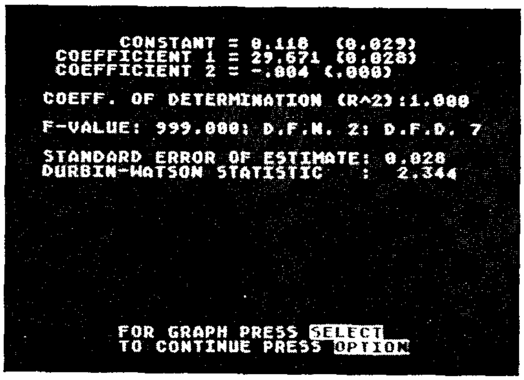


FIGURE 19



from that graph. Errors between the actual data and the fitted regression curve should be normally distributed and independent of each other and of the explanatory variables in the regression itself. Errors should also be independent through time.

The regression curve used by B/GRAPH is what is known as the "least squares fit". This means that the form of the curve is decided in advance (you input the degree of equation and the form of each degree; by which we mean how many non-constant terms and what form they take) and parameters are chosen so that the sum of the squares of the difference between the observed points and the fitted curve are at a minimum. When graphed, usually you will see that the observed points deviate from the fitted curve. This is due to such items as omission of variables in the function (such as unknowns, un-quantifiables, random or effects too small for reliable estimate), random behaviour (especially true where people are concerned), picking the wrong curve, poor aggregation of data during collection and errors in measurement.

DOING A REGRESSION

To explain how all of this works, use the Do command and call up the file PLANET. We will do a regression on the distance from the sun and orbital velocities of planets in the solar system. Planets are numbered sequentially from Mercury to Pluto, with Ceres being number five. You will be asked for the degree of equation when the file is loaded. This is an expression of the complexity of the equation which is in the form:

$Y = A + B \times f(x) + C \times g(x) + D \times h(x) + E \times r(x)$ etc.
where f, g, h, r are functions of x.

Each degree is the part of the formula after the constant "A". "A" is decided by the program and is given to you in the information screen which follows the calculations. The number of degrees should be kept low in relation to the number of points in order not to compromise the predictive abilities of B/GRAPH. For this particular file, we happen to know the relationship of the data; orbital velocity decreases inversely as the square root of the distance. So answer the degree with 2.

Next you will be asked for the form of the first degree. Here you can enter any valid equation which uses the variable X; *ie* SIN(X), X^2 or X × X, LOG(X) – SQR(X)/2. A simple linear regression would use merely "X" in a one degree equation. A more complex regression might use X, then X^2, then X^3 for the first, second and third degrees. The exact formula and form of the degrees will depend on the data. You must understand something about the data in order to curve it properly. For this example, input 1/SQR(X) for the first form and simply X for the second. If you enter the same form twice, the computer will be unable to solve the regression and after attempting to do so, will return to the menu. This happens because an infinite variety of solutions is possible.

Sometimes you will not be able to find the right curve to fit the data. You may be trying the wrong equation for the data in your file. The data may be related to one another but the formula for that relation may not be obvious. It is worth noting here that if your equation involves raising a number to a power, *ie*: X^3, the calculation will be substantially faster if you use the form X × X × X.

BUILT-IN FUNCTIONS

The Regression module allows the use of two built in functions; these are PI and I. To use PI in a formula that you are entering, simply type the letters 'PI' when required. The value of PI is calculated to eight decimal places of accuracy.

I is a variable which runs from one, up to the number of elements in your data file. This variable may be useful in situations where the first Factor is NOT a time series, but the nature of the Regression changes over time. Essentially this provides you with the ability to perform a three element Multiple Regression with I, the period counter, as the additional factor. For example, if you are performing a Regression on a two Factor data file, where the two Factors are SALES and POPULATION, by using I in your formula, you would essentially be adding a third Factor, that of a period counter, to the Regression analysis. Such a formula might be of the form SALES = 20,000 + (3 × POPULATION in thousands) + (10,000 × I).

Because the Regression module is not in reality designed for doing Multiple Regressions, you will find that the Plotting and Value Interpolation sections will not work properly if the variable I is used. (These features are discussed shortly.) However, the third Factor (Calculated Values) will be accurate. A true Multiple Regression module is scheduled for future release. Please contact Irata Press for details.

THE DATA SCREEN

The screen blanks for calculations; this speeds it up considerably. When done, you are presented with a screen of pertinent data for the regression. This information will tell you first about the equation and then about the nature of the regression curve and the suitability of it for the data presented. If you have what appears to be the wrong curve or there is evidence that something may be amiss, you can return to the equation using the **OPTION** key to go to Value interpolation, then through **R** and RETURN to get to the main menu and finally **C** for Change to change the equation. or you can go on to see the graph with **SELECT**, described further along in the tutorial.

CONSTANT AND COEFFICIENTS

The first piece of information on the screen is the Constant. This is the number determined by the equations to be the "A" in the formula above. Next are the Coefficients of the degrees you entered, as they were computed according to the formula. You can have up to eleven degrees in your equation, but if you do not have sufficient data for such a complex equation, the program will inform you and ask you to input a lower degree. The more data you have, the more accurate your regression. You can use the Constant and the Coefficients to plot a curve later on. This is discussed below under PLOTTING.

STANDARD DEVIATION OF COEFFICIENTS

The numbers in brackets, after the coefficient, are the standard deviations of the coefficients. They indicate the significance of the estimate of the coefficient. Assuming that you have at least 8 more data points than you do degrees in the regression, the true value of the coefficient will lie within 2 standard deviations of the value calculated; 95% of the time.

For example, if you had a coefficient of 10, calculated from the data, and the standard deviation was 1, then you are 95 percent confident that the true value of the coefficient is between 8

and 12. If the standard deviation is, say 6, then you would have to use −2 to 22 as your confidence limit. In that case you could not rule out the possibility that the coefficient was actually zero and that the variable in question had no actual relation to the dependent variable at all.

Thus the usual test of coefficients is to exclude any coefficient where the standard deviation is more than half the absolute value of the coefficient. Of course as in all things, this rule is not hard and fast. A researcher may have other reasons for keeping a variable even if the standard deviation is large. Similarly, there may be good reason to discard a variable even when the standard deviation is low. However if you are qualified to make such judgements you don't need us explaining (hopefully in simplistic terms) what a standard deviation is.

COEFFICIENT OF DETERMINATION

The Coefficient of Determination, known also as R-Squared (R^2), indicates the proportion of the total variation of the dependent variable (Y) which can be explained by the changes in the independent variable (X). Only in the case of a linear regression is this coefficient the square of the correlation coefficient.

This value is a measure of the closeness of fit, rounded to three decimal places, of the curve to the data. In this example, it is 1.000, since we already knew the proper equation and had a perfect set of observed data for our points. The range for this coefficient is zero to one; one being perfect, zero being terrible.

F-VALUE

The F-Value is a statistic which indicates the overall significance of the regression and the fit of the data to the curve. Taken in combination with the degrees of freedom in the numerator (D.F.N.) and denominator (D.F.D.), it is an indicator of the validity of the relationship between X (the variable you used in the equation) and Y (the dependent variable). The total of DFN and DFD are one less than the total number of elements in a factor (in our case nine where we have ten planets). The higher the F-value, the better; B/GRAPH only prints a maximum F-Value of 999; if the value is greater than that, only 999 is printed since a larger number isn't any more meaningful. You would compare this value against a table or use it in the Statistics package of B/GRAPH.

You will be able to use the F-value in the F test portion of the Statistics package (6 on the main menu) when you either wish to test special values or you wish to test a three factor data file when the F test only uses the first two factors. Here is a simple example of sales calls made by three salespersons during a week. Able and Baker made four calls each, Carter made five for a total of 14 sales calls. The means for their sales are 300, 500 and 500 respectively. The results are:

SIZE OF SALES MADE:

Sales call:	Able	Baker	Carter
1	300	600	700
2	400	300	300
3	300	300	400
4	500	400	600
5	0	0	500

The question is whether the average sales of these three are really different or merely due to chance. As mentioned in the Statistics section, B/GRAPH can not do this problem directly.

By assigning each salesperson a number — Able 1, Baker 2, Carter 3 — we can enter the data in two factors instead:

Sales:	Salesperson:	Sales:	Salesperson:	Sales:	Salesperson:
300	1	600	2	700	3
400	1	300	2	300	3
300	1	300	2	400	3
500	1	400	2	600	3
0	1	0	2	500	3

Now you can perform a linear regression on the data with one equation, form of degree = X. The

data screen will produce the F statistic as well as the number of degrees of freedom. Not only will the regression program tell you if there is a relationship, but it will also give you an estimate of the form of the relationship, proving a more powerful test than the F-test alone. This is referred to again in the F-test portion of the Statistics package.

STANDARD ERROR OF ESTIMATE

The Standard Error of Estimate is a number which indicates the relative deviations of the data points about the regression curve. The error comes in as the difference between your data and what you have calculated. It can be any positive value, with zero being perfect. In our PLANET example, the value is extremely low: .028.

DURBIN-WATSON

The Durbin-Watson Statistic measures autocorrelation; it tests the autocorrelation of errors, looking for a pattern, *ie*: is the error for point "t" related to the error for point "t-1"? If there is indication of autocorrelation, it often indicates that other factors are affecting the data that we are not taking into account.

The values for the Durbin-Watson Statistic range between zero and four with four a perfect negative and zero a perfect positive correlation. Two is perfect. It cannot detect non-linear or lagged correlation. To properly interpret this value, you need a set of statistical tables. If there is evidence of autocorrelation, the equation should be used with caution for projection purposes or a different form tried. This might be in the form of a different series of equations or perhaps altering the order of the factors using the file manipulation program. With small samples sizes, the Durbin-Watson statistic is of very limited value.

Autocorrelation is a form of correlation. In the Durbin-Watson test, you are correlating the data for the errors to themselves. You examine the error (difference between actual point and predicted point on the regression curve) at point "t" and compare it with another actual point at t-1 for their relationship.

FIGURE 20

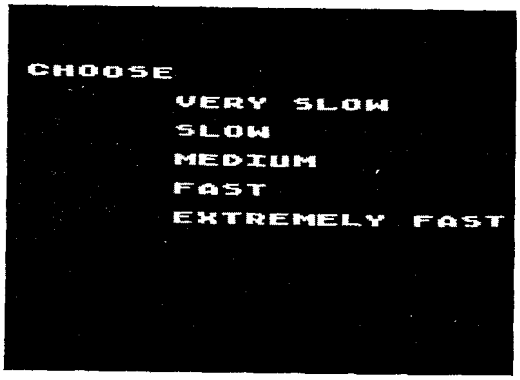
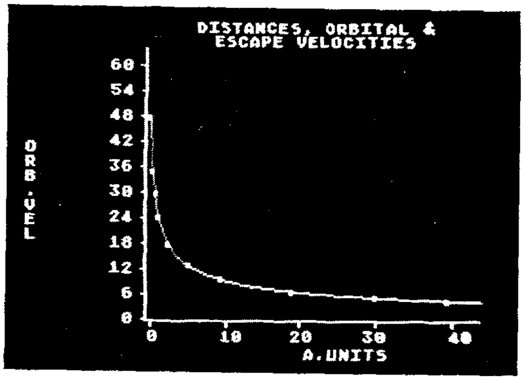


FIGURE 21



PRINTING THE DATA

The information on this screen may be printed by pressing the **START** key. Once you have done this, choose **SELECT** to see the actual graph.

DRAWING THE GRAPH

Before drawing, you are given a chance to choose the speed at which the graph will be drawn: Very Slow, Slow, Medium, Fast and Extremely Fast. The speed affects the accuracy of the graph itself; at Very Slow, each point (pixel) on the screen is calculated for the curve. At Slow, only every fifth point is plotted and a line drawn between them. It continues to the point where, using Extremely Fast, only four points are actually calculated. The use of this is seen on a simple linear curve where the graph plots the same at both ends of the selection. In this case, choose V. Later, you can go back to the menu and try different speeds by selecting the Change Regression option or by using Rescale and entering AUTO for a value choice.

The graph drawn shows the regression curve and the actual data points, plotted as small white squares or if you have more than fifty data points, small white dots. X and Y axis values are automatically calculated from the data but may be changed using Rescale as discussed below.

In this case the graph shows the distance from the sun in astronomical units (A.U.) on the X axis compared to a planet's orbital speed, on the Y axis. You may print this graph using **START** or examine the data in your graph by using **SELECT**. If you choose the latter, you will see a third column titled "COMPUTED" (remember that regression uses only the first two factors and that any third factor is destroyed in memory). This is the computed value for Y using the regression equation according to the formula you entered earlier. There will be a number of points shown corresponding to the data from the file you have loaded. The difference between the Y value and the computed value will give you an idea of the suitability of the regression. This screen may also be printed with **START**.

If you press **OPTION** to call up the menu page, you may return to the graph from the menu page with Redisplay. As with other graphs, **C**, **H**, **I** and **X** affect the color, hue and intensity of the screen. A special "zoom" capability is built into regression with the **R** for Rescale, available when the graph is displayed. You will be asked to give the maximums and minimums for both Y and X axes. This will allow you to focus in greater detail or greater scope on the graph, even enlarging it outside the boundaries of the given data to interpolate the curve. Rescale also allows you to change the speed of the graph drawing by typing **AUTO** when asked for a maximum value for Y.

CHANGING THE REGRESSION

To see what we mean about the suitability of data and the equation graphically, return to the main menu and use Change to try another equation. This time enter a three degree equation and when prompted enter X, X×X and finally X×X×X. Use a Very Slow draw again, for best accuracy. You will see that the curve emphatically does not fit the data, or vice versa.

To see another example, return to the menu and Load in the file ARM. This is a comparison of the arms expenditures, in $ billions, of the developing nations and the developed nations between 1960 and 1979. A third factor, total global foreign aid, will be eliminated in the computation process. Answer the first question with two degrees, and use forms X and LOG(X) when prompted, finally using Very Slow for the draw. You will see a fairly linear growth curve with quite a number of data points on it, some on, some outside the curve. Use Rescale to zoom into a portion where the points are the most dense to examine their actual relation to the regression curve. Try a Y axis of 30 and 10 and an X axis of 165 and 85. Unless you type AUTO, the graph will be drawn at the original speed chosen.

VALUE INTERPOLATION

Return to the function menu by pressing OPTION. With ARM still intact in memory, choose the V option from the function menu. This simply allows you to interpolate for the Y value from a given X. This allows you to examine specific points on the curve and to examine values that may lie outside it.

For example, enter 110. The Y value returned should be 352.889. This means that, given the regression we did above for this data, the arms expenditures of the developed nations will be at some $352 billion when the developing nations have reached $110 billion. At X = 500, the Y will be 1150.724. At 5000, the Y will be 9952.821 and you can see that the halfway point has been crossed. Hopefully, we will not need to see such incredible arms expenditures in our lifetimes!

You might try something different here; return to the function menu then to the main program menu and call up the FILE MANIPULATION PROGRAM. Load the file ARM again and go to Change the order of factors; replace factor one with factor 2 and vice versa. Save it under a different name and return to the Regression program. Call up your new file and, using the same equation, perform a regression. Now, when you want to examine the Value interpolation, you will be working the other way around: you will be giving the $ billions spent by the developed nations and seeing the interpolation of what the rest of the world will be spending. You should find the figures here quite close to those shown in the earlier interpolation example.

To print this page, you must type **P** and hit **return** (START will not work here). To return to the menu, type **R** and return.

PLOTTING A FUNCTION

Plotting allows you to plot two-dimensional functions and curves without an associated data file. Press P for Plot and then input any valid BASIC mathematical function for Y (see your BASIC Reference Manual for more information about BASIC mathematic formulae). The formula can be as simple as one function (Y = X or Y = SIN(X) for example. You don't input the Y; simply the other side of the equals sign) or as complex as you can fit into one logical line, as long as it is valid BASIC syntax. The only variable you can work with is X; any other will not give an accurate plot; instead an error message will be given and you will be returned to the formula input screen. It is not possible to use a formula like X × 1/Y. The exceptions to this are PI and I, discussed earlier.

For a simple graph, try SIN(X). You will be asked for the maximum and minimum Y and X values. Enter 1, −1, 100, −100 respectively. Choose a Very Slow draw routine at the next screen. This will give you a tight sine wave which will, on a color television, show you six colors on the screen, in GR.8, simultaneously. To experiment, use the Rescale function to increase or decrease the X axis.

For a more complex graph, try:

.118 + 29.671/SQR(X) − .004X

Use a maximum/minimum of 50 and zero for both X and Y and a Very Slow draw. If this curve looks familiar, it is basically the same as that drawn for the PLANET file. The formula simply uses the standard regression formula:

Y = A + B × f(x) + C × g(x) etc. (see the note on this equation, above),

taking for A the constant from the data screen for the PLANET regression, plus the degree one and two coefficients and multiplying them by the forms of the degrees entered earlier (1/SQR(X) and X). Press SELECT and examine the data; you will see that it fits quite well with the observed data in the PLANET file. Note that your equation is now the title across the top of the screen.

The Plot function is identical in every other way to the Regression function; it may be printed or saved, colors changed and rescaled. The Plot function is also quite useful for experimenting with curve types and various functions before entering them into a regression plot. Obviously, you do not get the data screen with coefficients and the like that you get when you do a regression. Remember that the graph is merely two-dimensional and works with only one variable: X.

When you call up the data screen using SELECT, you will get a number of points relative to the speed chosen for the draw: 100 for Very Slow, four for Extremely Fast. The maximum is 100; the first 100 points plotted. If you wish to see a greater range, choose the Slow or Medium speed which show fewer points but cover a wider range.

Plotting is very useful for creating graphs used in scientific applications. Many equations may be plotted using this function, such as exponential decay, Newton's Law of Cooling, the Michaelis-Menten model of enzyme saturation and others. We hope to produce special scientific engineering and finance application packages for use with B/GRAPH, in the near future. If you have mailed in your 'User Registration' card you will be advised of these updates as they become available.

CHI SQUARE SET UP

This program is a utility for use in the Chi square test in the statistics package. Since our statistical analysis works on only two factors, this program allows you to input a larger matrix of data and store it in a format easily used by the Chi square test routine.

There is only one major function in this set up program: Create a new set of data. Using this, you will be asked to input a number of rows (they run horizontally from left to right on the screen), followed by an input of the number of columns (vertically, top to bottom on the screen).

You then enter data for each column individually for the total number of rows. Remember that the Chi square test allows no N/A values. Entry is identical to that in either graph program; use the cursor keys to edit it and press the ESC key when finished. You will automatically be given the next column if there was more specified by your earlier input.

Once done, the computer will turn the data into two strings; actual and expected values which can be saved to disk using the Save function. Returning to the main menu by pressing Exit, you choose 5 to change the file from its ASCII format into a B/GRAPH format and then choose 6 for

Statistical analysis and use your file in the Chi square test. We save the file as an ASCII file to allow you to use the file in other programs and to allow us to provide you this program in an unprotected, listable program, so you can see how to set up data files for use in B/GRAPH by your own programs.

For example, let's say we were doing a study of six baseball players on their hits, walks and outs and wanted to see if they appeared equal on these statistics. We would set up the following table:

	PLAYER						
	A	B	C	D	E	F	Totals
Hits	10	7	13	8	14	8	60
Walks	5	5	0	1	3	6	20
Outs	28	20	30	20	10	12	120
Total	43	32	43	29	27	26	200

This would be entered into Chi square set up as three rows and six columns; the program itself will calculate the totals. it will also calculate the expecteds and saves them when you use the Save function, as factor two. Although you won't be able to see the expected data, it would look like this:

	EXPECTED PLAYER						
	A	B	C	D	E	F	Totals
Hits	12.9	9.6	12.9	8.7	8.1	7.8	60
Walks	4.3	3.2	4.3	2.9	2.7	2.6	20
Outs	25.8	19.2	25.8	17.4	16.2	15.6	120
Total	43	32	43	29	27	26	200

As you can see, the totals don't change. The Chi square statistic resulting from such a matrix is 21.36. The degrees of freedom is calculated by multiplying the (rows minus 1) by the (columns minus one) for a value of ten (you don't count total columns or rows for this calculation). You will be required to enter the degrees of freedom in the Chi-square test routine. B/GRAPH will not tell you the value, but as can be seen the calculation is trivial.

When you run this using the Chi square test, you see that the probability of getting a value of 21.36 is less than 2%, so at a 5% level of significance (the percentage or greater at which you are willing to accept the hypotheses), we would reject the hypothesis that these players were equal on these statistics.

CORRELATION ANALYSIS

This last program in B/GRAPH's statistical package allows you to test the correlation between two factors. The program ignores N/A elements and if only one factor is Loaded in, it becomes the second factor and the first is a simple increment of the ordinal numbers from one to the number of elements in the second factor.

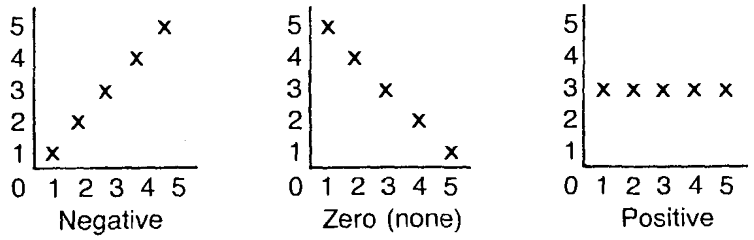
With the Simple correlation function, you test how well the elements in the factor(s) correlate with each other, in a linear manner (in regression this would be a one degree equation of the form X). You must Load a file first, since the program does not work with special values. You will be returned a Correlation coefficient when the computations are done. This value is the square root of the coefficient of determination, seen earlier in the regression program. It's faster than a regression if you have no interest in doing a full regression. It is used when there is a degree of linear relationship that appears to exist between the two factors; *ie* the Y factor moves upwards at a steady rate as a multiple of X.

The range is minus one to plus one, where +1 is a perfect positive correlation and −1 perfect negative. Zero means no apparent relationship, at least linearly. Points in a circle are related, but not linearly, so this is not a valid test for a circle. The danger is in interpreting the statistic for happenstance relationships such as an apparent correlation between murder and birth rates that are merely synchronistic rather than related (affecting each other). In North America, murder rates have followed an upward trend and birth rates have gone down, both rather steadily. A regression on this data will show an apparent relationship but they are in actuality unrelated. Factors may be correlated one to another on a lagged basis, which means that the data for one factor for time period T is related to the data for the other factor at time T-1 or T-2 etc.

The Rank correlation coefficient (also Spearman's test) is a simpler test; it requires two factors of the same size with no N/A's in them. The numbers must be ranks such as how you rated ten movies, on a scale from one to ten. Numbers may be duplicated (although they should not be for a proper test), but all must be in the range from one to ten. The second factor must be the same sort of rating but can, of course, be in a different order, say a ranking of movies done by a local reviewer. The Rank correlation coefficient tells you how closely the two rankings actually are.

The range is minus one to plus one, as in Simple correlation, with a positive number representing sameness of rank; the closer to one, the closer the correlations between the two factors.

Here is a graphic example of what we mean by correlation, or how well the data points relate to each other in a regular manner. Each graph displays one type of correlation:



NEGATIVE: Y values decrease as X values increase.
ZERO: X and Y values have no obvious linear correlation.
POSITIVE: Y values increase as X values increase.
EXIT

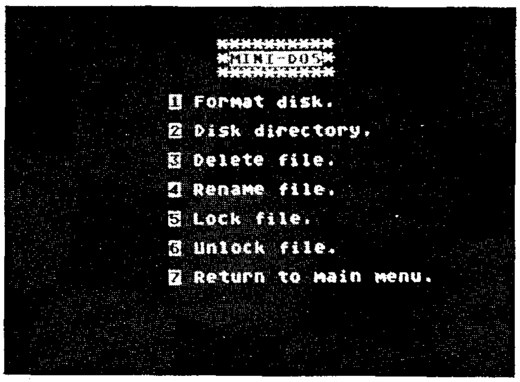
To return to the main menu again, type E for exit.

MINI-DOS

Mini-DOS (for Disk Operating System) is provided for the convenience of B/GRAPH owners so that they can perform the most common DOS functions without having to leave B/GRAPH.

Using this module you can Format a disk, read a disk Directory, Delete a file, Rename a file, Lock and Unlock files. For other DOS functions such as file transfer and copy, you will have to boot up a disk with your regular DOS on it. There is no regular DOS on B/GRAPH, so you cannot boot it from these disks.

FIGURE 22



Both Format and Delete functions ask you to type "Y" in order to proceed; this allows you to escape from the sequence in case you change your mind. Please exercise extreme(!) caution when FORMATing a disk as it is possible to accidently destroy data if the wrong disk is formatted.

This is a good time to remind you of the importance of making back-ups of your data disks. You can always obtain another copy of B/GRAPH, but data files that you have built up over months and years ma[illegible] irreplaceable. Always make a back-up of your data disk and store it separately from your working copy. Remember Murphy's Law: "Anything that can go wrong, will!"

Other Mini-DOS functions ask for a filename to proceed. Hitting **RETURN** will give you a disk directory, **ESC** will abort the sequence. Error messages will appear if you try to do a task not permitted, such as lock a file on a write-protected disk. You will be returned to the function menu. To return to the Main Menu, select 7.

A reminder on the Main Menu: selection E is for future enhancement disks which need B/GRAPH to run. Choosing this selection at present will do nothing. An enhancement disk needs to be available for anything to boot with this selection.

There are main menus on both B/GRAPH disks so that you can return to it from any program. Remember that the sample files and the Statistics, Regression, Chi Square Set Up and Correlation Analysis programs are on the second B/GRAPH disk.

APPENDIX A—PHOTOGRAPHING THE SCREEN

Although B/GRAPH has both screen dump and 'slide show' capabilities built in, you may also find it necessary or convenient to take color photographs of the various charts and graphs that you create.

Although there are services that will produce slides from your computer generated images or data, learning a few simple techniques will allow you to take color slides that will rival those produced by professional services.

THE EQUIPMENT

We strongly recommend that you use a single lens reflex (SLR) camera. This is the type that allows you to view what will be photographed through the picture taking lens. Most people will probably use a 35MM model since slides produced can easily be projected, printed or viewed in a hand viewer. You will find that it is virtually impossible to take a properly focused and framed slide of your TV or monitor screen with a twin lens reflex or range finder type camera.

LENSES AND TRIPODS

A lens with a focal length in the range of 50mm to 200mm will be suitable. A 105mm-135mm lens is ideal as the shorter focal lengths tend to accentuate screen curvature and distortion. If you are using a zoom lens, set it in the 150mm range, or its longest focal length. A firm tripod is a must. You can make do with a lightweight model but if you have any choice use the heaviest one you can.

ALIGNMENT AND FOCUSING

It is critical for best results that the camera be exactly at right angles to the picture tube. This applies to both axes; horizontal and vertical. You can do a pretty good job by judging this by eye, but the use of a small spirit or carpenter's level will help a great deal. You should move the tripod back and forth until you have filled the viewfinder with the full picture image. Remember that if you are producing 35mm slides, that the slide mount will cover about 10% of the corners of the film, so be prepared to experiment with your particular set up until you know what it will produce.

One of the most annoying results of a session of trying to photograph a monitor or TV screen, is to discover that some small point of light that you never noticed was reflected off the glass of the screen. The simplest solution is to not let that happen in the first place. Professional cameras are painted with black enamel for just this reason. If you have a chrome camera or tripod, try either placing some black tape or a dark non-reflective cloth over everything except the lens itself. If your screen image has a bright background, camera reflections can be a very real problem.

Naturally, the room should be totally dark, with all windows covered as best you can. Watch out for your eye glasses if you wear them. They are a wonderful source of screen reflection. Your best bet is to use a cable release with a long exposure and to stand well to the side rather than behind the camera. This will also help avoid reflections from watches and other jewelry as well as helping to avoid vibration.

EXPOSURE

We suggest that you use an ASA 64 film such as Kodachrome or Ektachrome. This will give you very fine grain, although any daylight balanced color film is acceptable.

A color TV image is produced on your screen by the electron beam scanning across the screen 60 times a second. Due to the possibility of conflict with the shutter on your camera, you should use a shutter speed setting of longer than 1/8 second. If you were to use a higher shutter speed you will either get a partial picture or dark lines on your slides. Play it safe and use a shutter speed of 1/2 second for all of your tests.

Since you are not using any light source other than your screen itself and screens differ in brightness, you will have to produce a series of tests. First, produce a few different graphs and charts that have a variety of combinations of colors and brightnesses. Three or four is sufficient, as you will have to run several exposures of each.

Set your TV or monitor for a good visual display, so that the screen image is at normal viewing brightness and contrast with the images reproduced by B/GRAPH, NOT from a regular TV show. The output intensity of your Atari may well be quite different than that of TV reception.

You will probably find that with a 64 ASA film and a 1/2 second exposure, an aperture setting of f5.6 will work well. Since as we said, your setup may be different than ours, you will have to bracket your exposures to find what's best for you.

Keep notes, and take at least six exposures of each graph, leaving everything unchanged except the f stop setting which should run the range from f3.5 to f8. in half stop increments. When your slides have been returned from processing, select the exposure that gives the most saturated colors. If, for example it is f5.6, then a combination setting of 64 ASA film, and a 1/2 second exposure at f5.6 will become your standard. It is always a good idea to bracket your exposures by a half stop on either side of your standard setting for each shot. This is regular practice by professional photographers and the slight additional cost is well offset by not having to redo a setup due to improper exposure.

Michael Reichmann

APPENDIX B— ARTIFACTING

In several places throughout this manual and tutorial we mention ARTIFACTING in reference to the appearance of colors on graph screens. Although an understanding of the technicalities are not necessary to be able to use B/GRAPH effectively, some users may find such a discussion of interest.

Of the 15 (or more, depending on the model) different graphics and text modes of which the Atari computers are capable, the one with the highest resolution (fineness of detail), is GRAPHICS MODE 8. *This is the graphics mode that B/GRAPH uses for ALL of its graphs and charts.* This mode has a resolution of 320 dots horizontally and 192 dots vertically. The limitation that goes hand in hand with this high resolution is that we are allowed only one color in two intensities.

If you have run B/GRAPH using a color TV or color monitor, you will have seen that we create graphs and charts with several different simultaneous colors; apparently as many as six at a time.

If you tried the Plot routine using SIN(x) in the Regression tutorial, you will have seen all six of the colors on screen at the same time. When a diagonal line is drawn, it may cause two adjacent dots to light up, creating another color effect. Again, this is not visible on a monochrome monitor where the diagonals merely appear brighter. You will also have noticed that one continuous diagonal line might have two or three colors along its length. This happens when the line shifts a dot row and lights up a different pair (usually consisting of one dot row or the former pair). With careful control, this effect can be used to your advantage to give your GR.8 pictures more color. Experiment with lines of differing degrees to see the effect. You can use our Plot function to do this to a limited degree.

We mention on some of our MENU screens and in the preceeding Tutorials that we can not tell you what colors you will see in a given situation and that we call them SOLID, ARTIFACT COLOR 1 and ARTIFACT COLOR 2, rather than calling them blue, green or red. Here then is the explanation.

If you look very closely at the face of a color TV, or use a magnifying glass, you will see that it is made up of alternating rows of RED, BLUE and GREEN dots. The way that a color TV image is created is by illuminating groups of these dots in varying intensities. This creates not only the images we see as TV pictures, but also all of the colors of the rainbow. Since the dots are so tiny, from normal viewing distances the dots blur together and the colors blend to produce a full range color TV image.

Your Atari computer produces color images in much the same manner as a TV station but through the use of the COLOR and SETCOLOR commands if you are using BASIC. In Graphics mode 8, the vertical resolution of the Atari is actually finer than the color resolution of a TV set. This means that a vertical line drawn on the screen may only light up one of the color dot rows and not the others. A horizontal line on the other hand will appear as a solid color since ALL of the dots in that row will be illuminated. It is through careful control of which vertical rows of dots are illuminated that we are able to display multiple colors in B/GRAPH even though we are using the Atari's one color high-res mode.

If you look at one of our screens on a monochrome monitor, you will see that what appears to be a solid color may in fact consist of parallel rows of vertical stripes. A TV has coarser resolution than the Atari and thus the vertical stripes blend together. This is what creates color where there should not be any. If you do a printer dump, you will see the colored areas as stripes. B/GRAPH has been carefully designed so that we use stripes and patterns for color artifacting that, when displayed on a monochrome monitor or a printer dump, allow you to clearly differentiate between areas.

Why then can we not tell you what colors you should be seeing? Over the years Atari has released computers with two different graphics control chips: the CTIA and the GTIA. These chips 'light up' different rows of colored dots. Also, Atari's XL series computers, although they have the GTIA chip, illuminate the same dots on a GRAPHICS 8 screen as a CTIA equipped model 400 or 800. Since your TV or monitor may not be perfectly adjusted in any event, it makes it impossible for us to be able to tell you how a given artifacted color will look on your particular screen. This is the reason we give you so much control over the color, hue and intensity of your display screen: you can adjust your graphs to suit your own tastes and TV set.

In our Custom Labeling Module, we allow you to place four different sizes of text, in three different colors, on any part of a graph or chart. Again, if you look at a printer dump, or a display on a monochrome monitor, you will see that the letters in some cases are made up of stripes. This again is from artifacting. Normally one is not able to place text on a GRAPHICS 8 screen, but we utilize a proprietary routine that maps the complete character set onto the high-res screen and by changing the sizes, allows you to create labels that exploit color artifacting to create large colored letters.

We hope that this brief description of a complex but easy to understand topic about the Atari, is of some help in understanding both B/GRAPH and your computer a little better. For more information on this and other relevant topics, we refer you to Mapping the Atari by Ian Chadwick, Compute Books and Compute's Second Book of Atari and Compute's First Book of Atari Graphics, all published by Compute! Books.

BIBLIOGRAPHY

If your interest in graphs and statistics in particular has been sparked by B/GRAPH, we offer the following brief bibliography. Though there are a great many books on statistical analysis on the market, and we certainly are not familiar with all of them, here are some that we can recommend. We have also included under 'Secondary Sources', a few books on the Atari in general that we consider to be indispensable reference works.

SALES FORECASTING
David L. Hurwood; Elliot S. Grossman;
Earl L. Bailey
The Conference Board Inc.
New York
1978

THEORY OF ECONOMETRICS 2ND ED.
A. Koutsoyiannis
The MacMillan Press Ltd.
London
1977

MARKETING RESEARCH — METHODOLOGICAL FOUNDATIONS 2ND ED.
Gilbert A. Churchill Jr.
Dryden Press
1979

STATISTICS WITHOUT TEARS
A Primer for Non-Mathematicians
Derek Rowntree
Pelican Books
Middlesex England
1981

FACTS FROM FIGURES
M.J. Moroney
Pelican Books
Middlesex England
1981

USES AND ABUSES OF STATISTICS
W.J. Reichmann
Pelican Books
Middlesex England
1981

STATISTICAL ANALYSIS 2ND ED.
Samual B. Richmond
Ronald Press
1964

COMPUTER SIMULATIONS IN BUSINESS
Hugh J. Watson
John Wiley & Sons Inc.
Toronto, Canada
1981

SECONDARY SOURCES

BASIC MICROCOMPUTER MODELS IN BIOLOGY
James D. Spain
Addison-Wessley Inc.
Toronto
1982

YOUR ATARI COMPUTER
Ion Poole
Osborne/McGraw Hill
Berkeley, California
1982

MAPPING THE ATARI
Ian Chadwick
Compute! Books
Greensboro, North Carolina
1983

DISK FILE DESCRIPTIONS

DATA FILES — DISK #2

PLANET is a three factor file suitable for graphs and regressions. It contains data for the distance in astronomical units, orbital and escape velocities in km/sec for all of the planets in order from Mercury out to Pluto. Planet five is actually Ceres; an asteroid included to show how well the curve actually fits the data. Source: Dynamic Astronomy, by Robert Dixon, Prentice Hall, 1980.

ARM is a three factor file for graphs and regressions, containing the amount, in billions of dollars, spent by the developing and developed nations in arms and foreign aid (world travel expenditures), between 1960 and 1979. Figures for expenditures by Lebanon and Cambodia are not included after 1975 since they seriously deviate from the curve and/or were involved in civil wars which made accounting difficult, to say the least. Source: World Military and Social Expenditures 1981, by Ruth Leger Sivard, World Priorities, 1981.

POP is a pie chart of world population figures by continent, from the 1979 census. Source: World Statistics in Brief, United Nations, 1981.

WATERL.PIE is a pie chart comparing French and Allied casualties in the four battles between June 16 and 18, 1815 that comprised the Waterloo Campaign. Source: The Campaigns of Napoleon, by David Chandler, MacMillan, 1966.

NAPWARS.1, **.2** and **.3** are casualty figures for selected battles in the Napoleonic Wars. ".1" is a bar chart comparison of total killed for French and Allied armies, ".2", a pie chart of Allied and ".3" a pie chart of French casualties. The latter two are useful in experimenting with Overlays in the line graph mode. Battles are listed by name in the pie chart versions. The total for these battles exceeds 800,000; the Napoleonic wars — all battles included — are responsible for more than 1,000,000 soldiers killed. This is merely the military casualties; civilian deaths, casualties in marches, wounded who died later, etc. are not taken into account. In the battle of Berezina alone, some 30,000 non-combatants were killed! Source: Chandler, as above.

JOBS is the twenty year trend in the number of military personnel, teachers and doctors in the world. In 1960 there were 9,851,000 military, 6,850,000 teachers and 1,226,000 doctors in the 28 nations of the developed world. In the 113 nations of the developing world the numbers were 8,699,000 military, (10,628,000 in 1969, due mostly to the number in Viet Nam) 7,946,000 teachers and 442,000 doctors. Twenty years later, in 1979, the figures were 9,501,000, 9,600,000 and 2,330,000 for the developed world and 14,934,000, 19,800,000 and 1,220,000 for the developing world. The U.N. statistics book mentioned above shows that while in the "third world", literacy dropped from 2 to 10% (except in South and Latin America where it rose considerably), the literacy rate in the "western" world" has decreased by only 1% at best (in Europe). Source: Sivard, as above.

CARS.STS is a test file used in the Statistics package, purporting to give sample data of defects in random samples of ten vehicles taken off an assembly line. It has no real world validity, it is simply used for the tutorial in B/GRAPH.

DEMO5.PIC (DISK #2) is sample graph Image which may be retrieved with the Labeling Module.

DEMO1.DAT (DISK #2) is the tutorial file used in the B/GRAPH tutorial section to demonstrate how to Display, Save, Update and perform other functions with a data disk file.

FONTS (DISK #2). You will notice, when doing a directory of Disk-#2, that there are a number of files with the extension .FNT. These are alter character sets, such as Hebrew, Russian (Cyrillic), Greek and so on. These are loaded by the Labeling program so that you can label your graph Images with not only different sized and colored text, by also in differing text styles and foreign alphabets.

B/GRAPH PROGRAM FILE DESCRIPTIONS

B/GRAPH offers a number of programs for both graphing and statistical analysis, plus utilities for file manipulation. These programs are written in a combination of BASIC and Machine Language. Every attempt has been made to provide the fastest, smoothest routines possible in every function.

The disk MUST be booted from a coldstart for these to work; they cannot be run using BASIC RUN or LOAD commands. The source code of the B/GRAPH programs took more than a man-year to prepare, and is therefore protected both to prevent illegal copying and to avoid casual tampering which might affect the accuracy of the computations.

Should you have any suggestions about the programs, or have any need for a specific application not covered here, please write to us. We will examine your suggestions and get back to you as soon as we can.

MENU (DISK #2) is simply the Main Menu. It is on each disk to facilitate exiting programs and entering new modules. Returning to the Main Menu is the only way to move between program modules, since we have disabled the BREAK and SYSTEM RESET keys. Since it exists on both B/GRAPH disks, you will not have to swap program disks if you simply are moving between programs on the same disk.

RESET PRINTER TYPE (START-DISK #1) allows you to choose another printer type from the printer menu. B/GRAPH currently supports Centronics, Epson, Prowriter; C.Itoh, NEC, Oki 92A and Seikosha printers which have graphics capabilities.

GRAPHING (GRAPH-DISK #1) is the main graphing program. It can prepare bar, point (Scatter), line, segmented or market (tic or connected) graphs, with up to three factors, multiple colors and rescalable values. It also allows you to change graph labels.

PIE CHARTS (PIE-DISK #1) is the pie chart graphing routine. It allows you to create pie (circular) charts of up to 16 elements and presents you with a graph with labels and percentages, in multiple colors and totals the data on the second screen.

GRAPH/IMAGING LABELING (SHOW-DISK #1) provides B/GRAPH owners with two major utilities; the ability to place four different sizes of text anywhere on a graphics screen in several different colors. It also allows labeling with multiple 'fonts', or character sets and secondly the ability to create and play back 'slide shows' of preprogramed Image sequences.

FILE MANIPULATION (CHANGE-DISK #1) is a file and data manipulation program. It performs functions such as factor rollover and exchange, algebraic operations on factors (including user-entered formulae), ASCII and VisiCalc(R) D.I.F. file conversions and insert and decrease factors. It also handles exponential smoothing, moving and geometric moving averages.

STATISTICAL ANALYSIS (STAT-DISK #2) is a package of statistical functions to analyse your data files, including T-test, F-test, Chi square test, Normal, Poisson and Binomial distribution probabilities and standard statistics (mean, median, quartiles, standard deviation, variance, skewness and kurtosis).

REGRESSION ANALYSIS (REGRESS-DISK #2) allows you to plot a regression curve with your data, entering degrees and forms of the equation. You may also plot a graph of any function you enter, and do value interpolation on either functions or regressions.

CORRELATION ANALYSIS (CORR-DISK #2) provides the correlation coefficient for two factors in your data files. It also does the Spearman Rank Correlation.

CHI SQUARE SET UP (CHI-DISK #2) allows you to use a large matrix for the Chi square test in our statistical analysis package. It saves data for actual and expected values in a file easily handled by B/GRAPH.

MINI-DOS FUNCTIONS (MINDOS-DISK #2) gives you the most commonly used DOS functions, such as format a disk, delete a file, lock/unlock a file and disk directory, all without having to leave BASIC or B/GRAPH. There is no regular Atari DOS on the B/GRAPH disks. This does not mean

you need to put DOS on our disks to use these programs; it only means you cannot load DOS from a B/GRAPH disk. Instead, we have provided Mini-DOS to offer you many DOS functions

PICLOAD.BAS (DISK #2) is a BASIC program which is designed to allow you to Load and display Images created with B/GRAPH. It will work with many screen dump programs that enable you to produce printouts of your graphs and charts in sizes that B/GRAPH is unable to handle. It is unprotected, and thus you may examine the code to see how we save and load Image files, and also, you may freely distribute it to anyone whom you wish to provide with a means of displaying B/GRAPH Images.

FONTROT.BAS (DISK #2) is another BASIC program which is used separately from the B/GRAPH programs. Its purpose is to allow you to rotate any font by 90 degree increments. The program is self prompting. A second pass will do a further 90 degree rotation (upside down) and so on. Since the normal Atari character set is in ROM (Read Only Memory) we have included a file called SIDEATR.FNT on Disk #2 as well. This is the regular Atari font rotated 90 degrees.

B/GRAPH contains a number of small files including TXTLONG, DUMPER and DRAW which are utility files used from time to time by the various B/GRAPH modules. These have no relevance to the user. You may also notice that some of the demo files mentioned may not be exactly as described, or they may be some additional files not mentioned here. This is because we are constantly working to improve B/GRAPH, and all minor enhancements cannot always be reflected in this documentation.

REFERENCE GUIDE

Almost every B/GRAPH function, in each of the program modules, is referenced through one of the many on-screen menus. The Tutorials for each program explain in detail not only what each Function does, but also the theory behind it.

This Reference Guide is intended as a quick guide to each of the major program functions, when the tutorial offers too much, and the on-screen menus, too little information.

MENUS

OPTION will display the main program menu if pressed while a graph or data screen is displayed.

R will always Redisplay a current graph from the main menu.

ESC may be pressed to return to the main function menu when checking a disk directory. It is also used to signify the termination of data entry. A third use is in the labeling module, where it is used to turn on and off the Labeling mode.

VIEWING DATA SCREENS

SELECT can be pressed at any time that a graph is displayed to show the data that was used to create the graph. P and B may be used to move forward and back a page (screen) if more than 20 items are to be displayed.

B for **Browse** and R for **Review** are used in some of the Statistical modules for examining data brought in from a disk file, and to see the results of calculations. These are noted in the main menu of the respective modules.

PRINTING GRAPHS AND DATA

START is always used when a graph or data screen is displayed to dump that screen to a printer. START is also used in combination with the other two Special Function keys in the Custom labeling Module.

DEFAULTS

RETURN is frequently used to signify that you wish the computer to proceed with the built in default values, if you do not wish to enter your own. An example of this is when entering graph labels. If no default value is available, the built in speaker will sound and you will be shown on the screen an example of the type of entry that is expected.

NON FUNCTIONING KEYS

BREAK has been disabled, and you will be unable to stop the program with this key.

SYSTEM RESET has been adjusted to produce a cold start reboot. In other words, it will destroy any data in memory and restart the program if Disk #1 is in Drive #1.

COLOR CONTROLS

C, H, I, and **X** represent Color, Hue, Intensity and eXchange. Pressing each of the first three will cycle through the range of available values. X will toggle alternately between reversed values of light and dark.

GRIDS AND BORDERS

G, V and **CTRL-G** and **CTRL-V** will produce dotted or solid horizontal and vertical grids on a displayed graph. These are toggle switches and removing a Grid line causes the graph to be redrawn for neatness.

B produces a top and right margin Border on a displayed graph, while CTRL-B just draws a right hand border.

F will automatically fill in the area under each line in a Line graph, producing what is known as an Area Graph.

SAVING AND IMAGING GRAPHS AND DATA

S is used in all modules to save the data and other information that was used to create a graph. D for **Display** is used to reload this data in the Graph and Pie modules, and **L** for **Load** in the Statistical module.

I is for **Image**, and this will save a displayed graph to disk in the form of a high resolution Image, or picture file. These can then be recalled in the Labeling module for display. This type of file does not contain any data, just the picture as displayed on the screen.

CURSOR KEYS

In any of the graphing modules you may use the cursor keys, including **INSERT** and **DELETE** to move the cursor around the screen. No input is updated until you press **ESC**. In the Labeling module these keys are used to position the on screen cursor to place text for Labeling.

SPECIAL LABELING KEY FUNCTIONS

ESC is used in the Labeling Module as a switch to alternate between Labeling and cursor movement modes.

SELECT will re-Image a graph back to disk, after Labeling is completed. Since the usual use for SELECT in the other modules is to display data, and there is no Data associated with an Image file, there should be little confusion on this point.

START + SELECT when pressed while an Image is displayed, will display a series of screens with questions on text size and color. These need to be answered before Labeling can be initiated, or when switching text sizes or colors at any other time.

OPTION + SELECT when pressed together while an Image is displayed and labeling is in progress, will allow you to load one of the nine special character fonts on Disk #2.

OTHER KEYS AND THEIR FUNCTIONS

$ is used in the input screen of the Graphing module to force a dollar sign to appear next to the 'Y' axes scaling, signifying that the data is in dollars.

R is for **Rescale**, and may be pressed at any time that a graph is displayed (except Pie Charts) so that the 'Y' axis may be rescaled.

A allows Point graphs to have a line drawn between points, Attaching them.

S permits the **Switching** between different types of Graphs while the current graph is displayed.

O will **Overlay** onto a currently displayed graph another graph from a data file on disk.

C is used to **Create** a new graph in both the Graphing and Pie Chart modules. Any data from a previous graph in memory will be destroyed.

These are the major functions that will allow you to begin using B/GRAPH. Combined with the on-screen menus and in-depth tutorials, you should find yourself comfortable with the command structure quite quickly.

REMEMBER

Anytime that a Graph is on the screen, you may press **OPTION** to redisplay the main Menu of that program module. Pressing **Redisplay** will then instantly bring back the graph. No data is ever lost unless you Exit the program module or Create a new graph. Make sure that you Save any graph first.

In cases where OPTION doesn't return you to the Menu (Help Screen), you will find that ESC usually will. If neither work, usually the program is waiting for you to answer a question, and RETURN will do the trick.

NOTES